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X-RAY THERAPY OF ENLARGED THYMUS.

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It is the purpose of this paper to report four cases of enlarged thymus treated by X-rays, to make a plea for the consideration of enlarged thymus as a separate entity, apart from the so-called status lymphaticus of Paltauf, and by experiments upon young rabbits to demonstrate the action of the X-ray upon the thymus.

Case 1. E. L., male, aged 7 weeks, was referred for X-ray treatment because of cyanosis and inspiratory stridor. The diagnosis of enlarged thymus was based upon the presence of an abnormal area of dullness over the upper part of the sternum.

The family history strongly supported this diagnosis. A previous child which was normally delivered at full term developed, a few days after birth, a marked cyanosis which persisted without remission. At the age of three months it began to have attacks of suspended respiration, with extreme cyanosis, which attacks were relieved by raising and lowering arms above head. This child died suddenly in one of these attacks at the age of four months.

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The present baby was delivered normally at full term, weight at birth, 6½ lbs. It was breast-fed. From birth it was noticed that the child's color was not good, appearing dusky and blue at times. When about two weeks old, he began to snuffle in respiration as though there were an obstruction in the nose. The respirations became wheezing in character and at times noisy. After crying, very rapid crowing inspirations would occur, and cyanosis very marked.

When presented for treatment child was seven weeks old, and weighed 8¼ lbs. Color was dusky, and at times decidedly blue, especially marked after crying. Mucous membranes were pale, hands and feet cold. The child was very restless, arms and legs jerking, and head and body constantly moving.

The respirations were accelerated and noisy. There was a snuffling in nose and wheezing in chest, alae nasi flared slightly in inspiration, and there was some retraction of the jugulum and intercostal spaces.

Chest examination revealed the above-mentioned area of dullness over the upper part of the sternum. Heart action was normal, although a diagnosis of congenital heart disease had been previously made.

Tonsils, liver and spleen were not enlarged, nor were any glands palpable.

Blood examination showed a white count of 12,000 with 60% small lymphocytes.

The skiagram which was made with difficulty because of great restlessness of child, showed a broadening of the upper mediastinal shadow.

X-ray exposures were given twice a week, the treatment extending over a period of two months, during which time fifteen exposures were made. The details of the technique need not be entered into here, save to say that all injury to the skin was avoided by using a leather and aluminum filter with a high tube.

The response was prompt. The dyspnoea and cyanosis rapidly improved, appearing only at infrequent intervals after crying and occasionally in morning on awakening. The restlessness disappeared, the child became quiet and playful.

Two and a half months after beginning treatment child appeared normal, except after a severe crying spell when slight duskiness would appear. The skiagram showed a decrease in the breadth of upper mediastinal shadow. When discharged from treatment, blood examination showed a white count of 9,500 with 35% small lymphocytes.

Case 2. Baby S. This case was reported in full by Dr. B. K. Rachford before the Association of American Physicians, May, 1910. It is from his notes that I make the following report:

The baby was delivered normally at full term, weight 6½ lbs. Breast-fed for one month, then weaned because of indigestion. When about a month old, mother noticed that the baby's feet were usually cold and often blue. At 5½ months had an afebrile attack of what was called "bronchitis," which lasted one month. Then a similar attack occurring at age of seven months with violent spasmodic cough and dyspnoea. This condition of cough and stridor continued three weeks when his adenoids were removed under chloroform anaesthesia in the hope of relieving his symptoms. Two days after the operation the symptom group recurred, now the stridor and dyspnoea interfered with his taking food. One month after the first operation a general and more radical operation was undertaken, for removal of tonsils and adenoids. A few days after this second operation, the symptoms reappeared and gradually increased until he was brought to Cincinnati two weeks later. In addition to the stridor and cyanosis there was a marked prostration. So urgent were the symptoms, that the child's father, who was a physician, prepared himself with tracheotomy instruments before leaving home as he feared a tracheotomy might be necessary on the train.

The physical examination as recorded by Dr. Rachford revealed an enlarged thymus by percussion. The child was pale, fat and flabby. Blood examination showed a chloranaemia and well marked lymphocytosis. Stridor was so constant and severe that the child could not take food. Attacks of paroxysmal cough and cyanosis coming on at short intervals

threatened his life. Lymphatic glands were palpable and spleen slightly enlarged. Tuberculin skin test was negative.

X-ray treatments were begun at once over the upper mediastinum, exposures being made over front and back. Child at this time was 9½ months old.

Within 48 hours after the first treatment there was slight improvement. This improvement continued uninterruptedly over six weeks, during which 13 treatments were given.

Cough and stridor had practically disappeared and the thymus dullness decreased to normal bounds.

Satisfactory radiographs of this case could not be obtained as the child, because of the stridor, would not remain quiet for even half a second.

Two weeks after returning to his home in Kentucky the father reported that the child was apparently well; at intervals of about three months thereafter, the child had three slight attacks of cough and dyspnoea. Each time he was brought to Cincinnati promptly, and given one or two X-ray treatments which at once dissipated the symptoms. One year after beginning the treatment the father reported that child seemed perfectly well.

Case 3. Baby N. was delivered normally at full term. The child breast-fed for three weeks and was then given in addition three bottles of milk a day because of insufficiency of mother's supply. At birth a rattling in the throat was heard and a few weeks later a crowing inspiration began. The picture was a peculiar one. In addition to the usual accompaniment of an inspiratory dyspnoea the child presented a prominence of the upper sternum, and a peculiar asymmetry of the chest. The right side of the chest bulged out prominently and the left side appeared sunken, there was an area of abnormal dullness over the upper mediastinum extending to the right. The clinical picture, however, was that of a foreign body in the left bronchus interfering with aeration of the left lung. The possibility of the presence of such a foreign body and the advisability of a bronchoscopic examination was under consideration when an X-ray plate was made. It showed a broadening of the upper mediastinal shadow, and X-ray treatments were begun by way of trial. The asym-

metry of the chest made the diagnosis of enlarged thymus appear somewhat doubtful. Furthermore, a blood examination of this child showed a practically normal blood picture for a child of this age. The tonsils, spleen and lymphatic glands did not appear enlarged.

At the beginning of X-ray treatment child was 3½ months old and weighed 12 lbs. The desperate condition of the child at this time was such that when the child was brought into the waiting room the crowing inspiration could be heard in the next room, although the door between the two rooms was closed. Ten treatments were given over a period of eight weeks. The improvement was prompt. The crowing subsided and nursing became less difficult. When discharged from treatment respiration was almost normal, stridor appearing only at intervals as after feeding or crying. Improvement continued during next two months, after which slight wheezing would occur at infrequent intervals, especially noticed early in morning. Child's development was progressive, gaining about one pound a month, and when last heard from was one year old and weighed 18 lbs. The mother reported that some wheezing still occurs at times, especially during sleep. A few more X-ray treatments would be probably advisable in this case, but as the symptoms are so slight and the child's development is progressive, the normal involution of the gland may be awaited.

Case 4. Baby B. aged seven months. There was nothing noteworthy in the previous history of the child. The present complaint began several months before beginning the X-ray treatment. The mother noticed that the child made a rattling noise in breathing, which noise was especially marked during nursing and immediately thereafter and when the child becomes excited. The child seemed nervous and restless. During the night the child would awake suddenly and would cry and seem to have difficulty in breathing. Upon examination the child appeared restless, although bright for its age. The skin and mucous membranes were pale. Tonsils, lymphatic glands and spleen were not enlarged. Blood examination showed a chloranaemia but no marked lymphocytosis. Inspiration was audible at all times and when

the child became excited a peculiar rattle accompanied the inspiration. Percussion revealed a slight dullness over the upper mediastinum.

X-ray plate showed a broadening of the upper mediastinal shadow, especially to the left.

Seven X-ray treatments were given which improved the child so much that the mother considered the child cured and although further treatment was advised failed to bring the child in. The child began to gain steadily in weight, seemed cheerful and slept well.

Since 1858 (2) when the first exhaustive monograph upon the anatomy of the thymus gland appeared, the literature of this organ has been largely speculative, often contradictory. Not only is the physiology and pathology of the gland very uncertain, but even its anatomy, both gross and minute, is unsettled. That the gland is always present and relatively large at birth, and that it continues to increase up to puberty and then gradually involutes, seems to be the commonly accepted view.

The most recent work upon the histology of the thymus is by Pappenheimer (3). The thymus arises from the endodermal epithelium of the third branchial clefts and is therefore epithelial in origin. Histologically the thymus consists of large irregular reticular cells, with irregular prolongation forming a protoplasmic network in which the small thymus cells are scattered. These small thymus cells bear close resemblance to the small lymphocytes of the blood, but according to Pappenheimer can be differentiated from the small lymphocyte by the fact that the protoplasm of the small thymus cell is almost invisible, being never sharply circumscribed and frequently shows cellular connections with the reticulate epithelium. It is furthermore never intensely basiphilic. The thymus gland further differs from a lymph gland by the absence of a definite capsule, by the absence of a fibrous reticulum, and by the presence of such peculiarly differentiated structural elements as the mononuclear oxyphilic granular cells, the Hassall bodies and the myoid cells. The thymus histogenetically and histologically bears an uncertain relation if any to the lymph glands. While an enlarged

thymus is usually accompanied by the condition known as status lymphaticus of Paltauf (4) either as a concomitant lesion, as a cause of the status lymphaticus as suggested by Hart (5), or as an effect, yet in many cases of pronounced status lymphaticus the thymus is only very slightly or not at all enlarged. The microscopic findings in the thymus are not distinctly abnormal in any case of status lymphaticus except possibly some indication of delayed involution. In two of the cases of enlarged thymus here reported there were no signs of status lymphaticus such as enlarged tonsils, lymph glands and spleen, nor was there any lymphocytosis in these two cases. Furthermore, it is well known that the thymus may enlarge in any chronic infection, and that it is regularly enlarged in Addison's disease, and in exophthalmic goitre. Enlargement of the thymus, therefore, may be considered as a separate entity apart from the status lymphaticus of Paltauf, although it is the usual accompaniment of the latter, and the profound influence of the X-ray upon thymic enlargement of whatever origin should be borne in mind. This action of the X-ray upon the thymus is analagous to its action upon the spermatogenic epithelium of the testicles, or if we accept the lymphatic origin of the thymus, is comparable to the destruction of lymphocytes in lymphatic enlargements or in leukaemia.

Many of the pathological reports of so-called thymus deaths are misleading, first, because the histology of the thymus is generally unfamiliar, and secondly, because the normal weight of the thymus at any given age is uncertain. The weight at birth according to Hochsinger (6) is 3.6 G., with a gradual increase until the tenth year, after which it decreases, and after puberty disappears altogether. Friedleben gives 14 G. as the weight at birth. The generally accepted weight for the new-born is from 13 to 15 G., although it varies from 7 to 25 G. It is generally conceded that it increases up to puberty or a little beyond, when it may reach 20-25 G., after which it undergoes involution. According to Zezas (7) any persistence of an appreciable amount of gland tissue after twenty years is abnormal, whereas Pappenheimer concludes that the thymus is functional more or less throughout life.

Hammer's (8) table gives 13 G. at birth, increasing to 37 G. at 15, down to 24 G. at 25 years, and then a gradual decrease to 6 G. at 70 years.

With such a great normal variation in the weight of the thymus the clinical diagnosis of enlargement of the thymus unless there are definite pressure symptoms, may be uncertain. The normal thymus in children according to some recent work of Levison (9) cannot be percussed, nor does it cast a shadow upon the X-ray plate. But an enlarged thymus if it be enlarged laterally can be percussed, and gives definite skiagraphic evidence of its presence. Hochsinger has shown that this area of abnormal dullness and this abnormal X-ray shadow appears continuous with the upper border of the heart and is often mistaken for an upward enlargement of the heart boundaries. But for the production of pressure effects, it is chiefly the thickness of the gland that is of importance. In the new-born the distance between the sternum and the spine is not more than 2 cm., and a thymus which is enlarged antero-posteriorally and not laterally may evert serious pressure upon trachea or superior-cava without being evident to percussion or upon the radiograph. Denecke (10) reports such a case in which there was no thymic dullness. Yet, by a thymectomy, all the pressure symptoms were removed.

In all four cases here reported the symptoms were those of actual pressure upon air passages and blood vessels. This question of actual mechanical pressure by an enlarged thymus has been much discussed and doubted by some, notably Paltauf, because of the fact, that in many cases of "thymus deaths" the thymus, while enlarged, did not at autopsy seem to be compressing trachea or veins.

Drawing my conclusions from cases recorded in the literature, thymus deaths may be grouped under three headings. The first group includes those cases in which there are actual pressure symptoms appearing some time before death and the post-mortem reveals evidence of pressure upon the mediastinal contents. In the second group, the thymus while enlarged does not produce any prodromal pressure symptoms during life, and the post-mortem shows enlargement but no actual signs of pressure. The fatal issue in these cases is

explained by a sudden swelling of the thymus, due to some exertion, as in crying, or due to some interference with the circulation as produced by certain positions of the patient, or as would occur in giving an anaesthetic. In these cases a vicious circle is established. In addition to the swollen thymus, the mediastinal veins become distended and the heart dilated which again react on the swollen thymus, the combination producing death.

In the third group, the deaths are extremely sudden without evidence of mediastinal pressure of any kind. Upon autopsy the thymus may or may not be enlarged. This group includes the true status lymphaticus of Paltauf, and the cause of death, according to Svehla's (11) theory and experiments, is "Hyperthymization."

However, the post-mortem state of the gland is not a criterion of its volume and relations during life, for vascular turgescence of the gland during life alters these relations. The swollen thymus presses upon veins which in turn become turgid and react on the thymus, thus greatly increasing the mediastinal pressure. The phenomenon was evidenced in Case 2 of this series. Placing the child on the abdomen with the head hanging low decreased the stridor, whereas, when the child was in the dorsal decubitus with head extended the pressure was increased. After Case 4 was discharged from treatment when the child slept with head thrown back, some stridor would appear.

Hedinger (12) in autopsies in 18 cases of "thymus deaths" in infants demonstrated pressure in the trachea in each case. Beneke (13) made similar observations and emphasized the fact that the simple throwing back of the head is often the direct cause of the sudden death. Rehn (14) by excising a small piece of the thymus and thus immediately relieving the symptoms, first proved by operative procedure that the thymus was exerting mechanical pressure. Jackson (15) by bronchoscopy demonstrated actual pressure upon the trachea in a case of enlarged thymus without any accompanying signs of status lymphaticus.

This increased mediastinal pressure is often exerted in asymmetric manner. It may interfere with the aeration of

one or the other apex and produce misleading physical signs. Such anomalous physical signs were noted in several of the cases here reported. Oelsnitz (16) considers asymmetry of the chest especially characteristic of thymic enlargement, having observed it in six cases. Oelsnitz's observations served to dissipate the doubt in diagnosis in Case 3, which presented such marked asymmetry of the chest. Denecke (10) has reported a case in which a swelling of the superficial veins of the neck during crying was the only symptom of an enlarged thymus.

If, however, we put aside the pressure theory and accept Svehla's theory of hyperthymization in support of which he demonstrated that thymic extract injected into dogs produced full blood pressure, acceleration of pulse and death by suffocation, X-ray therapy may still be rationally employed, for with a decrease in the size of the thymus we may expect a diminution in the amount of secretion.

In this connection I may briefly mention a fifth case with marked constitutional symptoms but no marked pressure effects, the details of which are reported by Dr. Rachford.

The child, aged 16 months, was fat, flabby, anaemic and markedly lacking in physical development. Heart was dilated, pulse rapid, spleen, lymph-nodes and tonsils enlarged, and lymphocytosis marked. The thymus was enlarged upon percussion. The pressure symptoms were in the background and consisted in some shortness of breath, brought on by slight exertion. In twelve X-ray treatments, during six weeks, all of the above symptoms improved, lymph-nodes and spleen returned to normal. A severe anaemia persisted, which required appropriate treatment, for further details of which reference may be made to the original report. As in the other cases there was a slight recurrence of the symptoms, which have required a few more X-ray treatments.

In this case the enlarged lymphatic glands, spleen and the lymphocytosis returned to normal after the thymus was reduced by irradiation, although spleen and enlarged lymphatic glands received no X-ray exposures.

Over three years ago there was presented before the Cincinnati Academy of Medicine by Dr. Alfred Friedlander (1)

the first case of enlargement of the thymus successfully treated by X-ray exposures. The patient was a child five weeks old, presenting inspiratory stridor, asthmatic attacks, cyanosis, enlarged spleen and lymphatic glands. Upon these symptoms together with an abnormal area of dullness over the upper part of the sternum extending laterally about 2 cm. to the right, a diagnosis of status lymphaticus and enlargement of the thymus was based. Nine X-ray treatments were given over a period of three weeks by the late Wm. H. Crane. The symptoms promptly subsided, and except for some pallor and slight cough the child developed normally. This plan of treatment was suggested by the classical experiments of Heinicke, who found that X-ray exposures had a profound influence upon the lymphoid tissues of young Guinea pigs, rabbits and dogs.

Since this original case, there is, aside from the five cases mentioned in this report, but one other case of X-ray treatment of enlargement of the thymus on record (a case by Myers quoted by Zezas), although various writers have referred to this method of treatment. By the operative method of removal of a portion of the thymus, many cases have been recorded. Zezas, up to Jan., 1910, collected 21 cases of so-called thymectomy from the literature with a mortality of 14%. By this operation but a small piece of the upper pole of the gland is removed, to relieve the urgent pressure.

In practically all of the operated cases on record the immediate result was an improvement in the urgent pressure symptoms, but not a complete relief of all the symptoms. The cure was later completed by the normal involution of the gland or by the relative decrease in the size of the gland, that is, the dimensions of the child's chest increase relatively more than the thymus and thus the pressure is removed.

The X-ray treatment is intended to accomplish similar results, except that the gland as a whole is decreased in size. The great advantage of the X-ray method is that it is free from danger.

Complete atrophy of the gland is not the desired result of X-ray therapy, and the treatments should not be pushed to

that end. That the gland was merely reduced somewhat in size in the cases here reported is evidenced by the fact that there were in each case, slight recurrences of symptoms referable to an enlarged thymus, and by the fact that these symptoms could in one case be elicited after the X-ray treatment was completed by throwing the head backward, thus showing that the thymus was still of fair proportion. In another case, an X-ray plate made after stopping the treatment showed a decrease in size, but not a disappearance of the gland. As the experiments upon rabbits indicate, we can push the involution process as far as desired, and can avoid any possible after-effects as might arise from a complete atrophy of the gland. Our clinical experience of the slight recurrences and the experiments of Rudberg (18) upon rabbits show that a regeneration of a mild type follows the X-ray destruction, and this fact further guards against the production of complete atrophy of the gland.

Upon considering the tendency to recurrence after X-ray treatment in each case and noting the experiments of Rudberg showing rapid regeneration following irradition, it would seem that the X-ray exposures were given too conservatively in these cases. The vague fears of the mother as to the possible harmful effects of the ray, which fears are not infrequently shared by the physician often cause the X-ray operator to err on the side of conservatism and to treat too lightly and discontinue the treatment too soon.

Therefore, in view of the difficulty often encountered in the diagnosis of thymic enlargements, and in view of the prompt action and the harmlessness of a few X-ray exposures, Roentgen therapy may be rationally employed as a therapeutic test in obscure cases.

A failure of the X-ray treatment in a recent case has called attention to one disadvantage of this form of treatment. In X-ray therapy there is a latent period of 7 to 14 days between the time of giving the exposure and the time of the desired effects. The case referred to was that of a very young infant (8 or 10 days old) with urgent symptoms of thymic pressure as well as hyperthymization as evidenced

by an extremely rapid heart action. This child died after receiving 4 treatments over a period of 6 days, well within the latent period for X-ray action. In such urgent cases where death appears to be a matter of a very few days thymectomy, followed perhaps by X-ray therapy, would seem to offer the best prospects.

To verify the above clinical results, the effect of the X-ray upon the thymus was studied experimentally, at the suggestion of Dr. Friedlander. For the experiments, young rabbits were selected, as it was found that they normally have a relatively large thymus. Brief reports of the first two series will be given.

Series one consisted of five rabbits seven weeks old, all of the same litter.

Rabbit No. 1, the first control (weight 825 Gms.) was killed at once and a large plump thymus was found weighing .55 Gms.

Rabbits 2, 3 and 4 were then subjected to X-ray exposures. A Walter 5 tube was used passing two milliamperes, target-skin distance—8 inches. Exposures of 15 minutes each were given three times a week. The rays were filtered through a lead and aluminum filter. All exposures were made over the ventral aspect of the thymus, the rest of the body was protected by a lead screen.

Rabbit No. 2 (weight 760 Gms.) was killed after receiving nine treatments over a period of 3½ weeks (body weight 840 Gms.). A small somewhat shriveled thymus was found, weighing .33 Gms.

Rabbit No. 3 (weight 680 Gms.) was killed after twelve treatments, over 4½ weeks (weight 675 Gms.). A very small thymus was found, weighing only .11 Gms.

Rabbit No. 4 (weight 790 Gms.) was killed after fifteen treatments, over 5½ weeks. Upon autopsy, the thymus had practically vanished. Some few small masses of what was apparently gland tissue and fat were found in the fascial covering of the great vessels. But so scant were these masses that no attempt was made to remove them for microscopic study.

Rabbit No. 5 (weight 755 Gms.) second control was then killed, and a large plump thymus weighing .44 Gms. was found.

Series No. 2 consisted of 5 rabbits, four weeks old, all of the same litter.

No. 1 (weight 275 Gms.)killed, as first control had a plump thymus, weighing .22 Gms.

Exposures upon Nos. 2, 3 and 4 were made as in the previous series, except that a Walter 4 tube was used, and the time of each exposure increased to 20 minutes. Twelve exposures over a period of three weeks were given.

The autopsy in each case revealed practical disappearance of the thymus. A few apparent gland remains and some fat masses could be seen in a thin connective tissue network. These remains were removed and prepared for microscopic study, which has not yet been completed, but it is likely that only a few traces of thymus gland tissue will be found. The weights of the tissue removed (consisting of fat, connective tissue and possibly some remains of the thymus) were respectively .020 Gms., .025 Gms., .01 Gm. The untreated control was then killed and a plump thymus was removed weighing .17 Gms.

The microscopic changes which were found in the atrophied glands of the first series were those of fibrosis.

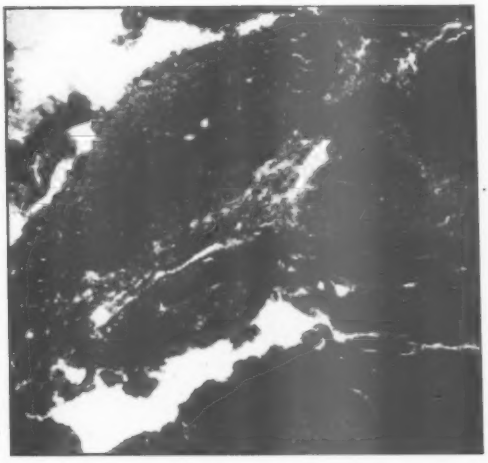
The thymus of Rabbit No. 2, series 1, which was only partially atrophied, showed a great increase of the fibrous tissue separating the cell masses. Great bundles of it were seen penetrating the cells and apparently crowding them out.

In Rabbit No. 3, series 1, in which the thymus was very small and shriveled, only a few cell masses could be seen lying among dense bundles of connective tissue.

A study of the finer microscopic changes in the cells themselves will be,given in a later report by Dr. Friedlander.

Interesting to note is the fact that thymus of the young rabbits of series 2 were more easily dissipated than those of the older rabbits of series 1.

Of great practical importance is the fact, that in neither series was there any alopecia produced by the X-ray exposures. In series 1, the hair over the exposed area was



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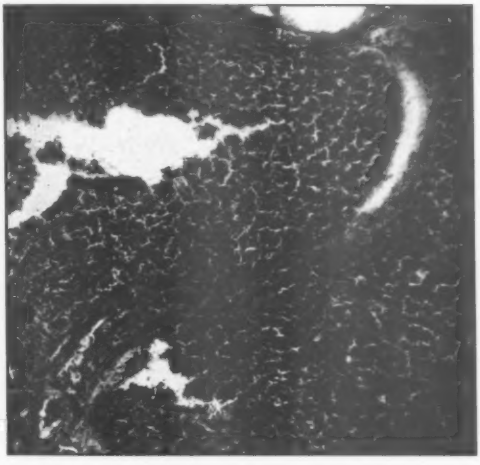

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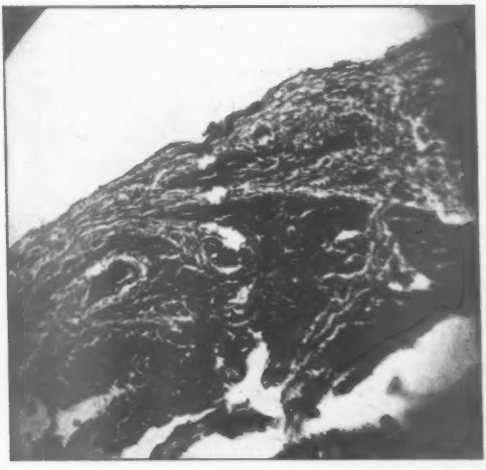

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The photomicrographs for this article were made in the scientific laboratory of Parke, Davis & Co.

No. 1. Section of normal thymus of rabbit.

No. 2. Section of thymus of rabbit after moderate irradiation with diminution of glandular cells.

No. 3. Section of thymus of rabbit after severe irradiation, with disappearance of glandular elements and excess of fibrous tissue.

somewhat looser than over the rest of the body, but in series 2 no evidence of loosening of the hairs could be detected.

Note—Since writing this paper it was ascertained that Case 1 died six months after being discharged from treatment. Death was apparently due to a recurrence of the pressure symptoms. This again emphasizes the danger of recurrence of symptoms due to regeneration of the gland and the necessity of keeping the patients under observation for some time. As this patient was the first case treated, I was not aware of this possibility and did not instruct the mother regarding it.

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DISCUSSION.

DR. HENRY K. PANCOAST, PHILADELPHIA.

The Society should feel grateful to Dr. Lange for this report on something new. This is a treatment which is undoubtedly of great value. Another reason why this report is a valuable one is that Dr. Lange not only gave us his results, but also an unbroken chain of reasoning for the existence of these results on anatomic and pathologic grounds, and later he will give us the microscopic report. That is the most important part of all in this work. If he has not already done so, he should note the effect of radiation on the thymus gland in different stages of treatment. In that way only can we prove what the effect of the ray is. The effect of radiation on a gland depends largely on its histology and in the case of the thymus that is a matter of doubt, as Dr. Lange mentioned. I think that I can see an explanation for the effect of the ray on the gland. If it consisted of epithelial tissue alone, I do not believe the effect from radiation would be as great as it is. The thymus is developed from the third branchial cleft as an epithelial organ primarily. Later, however, the gland is invaded by lymph tissue, which makes the treatment of this gland especially interesting to me because of my studies on the effect of radiation on the blood-forming organs. I have come to believe that the effect is largely due to the action of the rays on lymphoid structure. This is destroyed and to some extent there is also destruction of the epithelial tissue, leaving only the connective tissue. This being newly-formed lymphoid tissue in the infant suggests what we might find in an ordinary tymph gland.

This brings up another subject, which was suggested by Dr. Pfahler. If we are treating lymphoid structure which responds to X-ray treatment in an unusual way, as is the case in the lymphoid enlargements occurring in leukemia, there is a very rapid destruction of that lymphoid tissue, and we must be extremely careful of our dosage. We are treating infants

and toxemia in infants is a very dangerous matter. Therefore be careful how you treat these cases. Prolonged or severe radiation may produce a toxemia which will prove overwhelming and terminate in death of the patient. If all we have heard is true, we have here a new and interesting field for X-ray work, especially if the effect of the ray on lymph tissue is what I believe it to be.

DR. W. F. MANGES, PHILADELPHIA.

I have had a case of this kind to treat in the past year. The patient was a child, six or seven months old. The symptoms came on suddenly and were quite severe. There was great difficulty in breathing and at times respiration was spasmodic, particularly when the child was excited or was made to cry. It would become unconscious. Then the spasm would pass over and the child would breathe normally again. There was at all times a peculiar wheezing sound during respiration. A diagnosis of enlargement of the thymus was made by a prominent practitioner in the city of Philadelphia. He asked me what I thought could be done with the Roentgen ray and, basing an opinion on the fact that the ray reduced other enlarged glands, I told him that an improvement could possibly be obtained. I began the treatment by giving short exposures, placing the tube at some distance and using the filter. I was surprised at the result. The child soon began to sleep better and while it still had spasmodic attacks when crying, there was no wheezing. The child continued to improve. I treated it twice a week for about two months. The wheezing finally disappeared entirely and the spasmodic attacks were few and far between. Then, for fear that I might do too much, I stopped the treatments and waited. I did not see the child for three months. The mother told me it was beginning to wheeze again. I gave a few more treatments and have not heard from the patient again. This was last February. I am sure the child is well, because otherwise it would have returned to me.

DR. F. H. BAETJER, BALTIMORE.

Dr. Lange said he thought that in some cases the treatment might be used therapeutically. I have been interested in the thymus from a diagnostic standpoint. We have had several cases where it was difficult to tell whether it was a case of mediastinal growth or enlargement of the thymus. We found that when the thymus is large enough to be seen, if you will elevate the chin as much as you can, you will get a difference in the percussion note where the shadow appears on the plate.

DR. D. R. BOWEN, ROME, N. Y.

I understood Dr. Taylor to say last evening that he would give us something on the measurement of the dose. I would like to know more about this, particularly because of a recent article by Schwartz, who used a mixture of a solution of corrosive sublimate and ammonium oxalate which, when exposed to the rays, becomes cloudy. He considered three of these units to be sufficient.

DR. A. M. COLE, INDIANAPOLIS, IND.

Dr. Lange has given us a very excellent paper, and I want to commend his wisdom in treating these cases lightly. Some years ago a prominent nerve specialist treated a case of Hodgkins' disease with the Roentgen ray. He used a high tube and gave long exposures. The patient immediately developed severe toxic symptoms and died in a few days. The Doctor was frank enough to confess his trouble before the local medical society. The newspapers got hold of it and published it far and wide, greatly to the discredit of the Roentgen ray.

This is a very interesting subject, and what the effects of the Ray are upon these ductless glands I do not believe we as yet fully understand. I remember reading a book several years ago on the ductless glands and the writer made great claims for the effects of their secretion upon the general health. It was mostly theory, but nevertheless interesting.

No doubt the Ray has a certain stimulating effect upon the secretion of these glands and it may be due to this that we so often notice a tonic effect in using the Ray upon different diseases. I have noticed time and again when treating a carcinoma of the breast where the body generally is exposed that the patients will often say they feel better and stronger after a few exposures have been given. This may be the general effects of the Ray upon the ductless glands. .

In this same line we may consider the effects of the Ray upon the opsonic index which Dr. Crane touched upon in a paper before this society two years ago. In my own mind I feel certain that the Ray has an effect upon the system generally that might be called tonic; and whether it is due to the effects upon the ductless glands, the opsonic index or what not, I am sure that we see it clinically.

This excellent paper of Dr. Lange's does demonstrate that the Ray will cause a partial atrophy of the Thymus gland and thereby will cure the train of symptoms associated with its enlargement. I consider this paper one of the most valuable contributions to Roentgen Therapy.

DR. GEORGE C. JOHNSTON, PITTSBURG, PA.

I saw a child which presented a definite picture of enlargement of the thymus, but the history was peculiar in that the father of the child, a well-posted physician, said that the baby had been born with the croup, that the first cry it gave was a croupy cry. The history of most of these cases is that the thymus enlarges progressively after birth, the enlargement beginning shortly after birth, but I did not find any history of a child being born with a thymus gland sufficiently large to cause trouble. Therefore, I doubted the diagnosis. I lifted the chin as much as possible and pulled the thymus up above the shadow of the manubrium, but the plate did not show the picture we looked for. It is usually safe to diagnosticate an enlargement of the thymus if a shadow is visible on either side of the manubrium. This plate did not show that shadow, so that I was unable to make a

diagnosis. There was a very faint shadow which seemed to be extensive and resembled a mediastinal growth, but it was too high up in the neck to be such a growth. The child grew progressively worse, so that an operation was necessary. Body temperature was never elevated. The operation was performed. The moment the surgeon had made the incision and began to dissect back to the side of the larynx, there was a gush of pus, about two ounces being evacuated. It was a case of congenital post-laryngeal abscess, which was quite new to me. The child made a rapid recovery.

DR. LANGE (closing the discussion.)

Case 3 of my series was born with a crowing inspiration and, strange enough, this case presented the picture of a foreign body in the bronchus. We made a tentative diagnosis. One side of the chest was bulging; the other side was sunken. There was a prominence over the sternum. In looking up the literature, I found a report of a case by Oelsnitz, in the Presse Medicale. He says the thymus rarely enlarges symmetrically. It may extend down on one side or the other, and interfere with the symmetry of the chest. In three plates I made of this case there were such areas in the lung, which we could not explain. One man said he could get an area of dullness and we got a hazy shadow, showing that there must have been less air on one side than on the other. You must cast these things aside and regard them as symmetrical symptoms due to enlarged thymus. We called this a case of deficient aeration, but would not go so far as to call them cases of atelectasis.

As to the histogenesis of the gland, that is exceedingly doubtful. The invasion of the lymphoid cells is very doubtful. Pappenheimer's theory is the correct one, that there is no such invasion of the lymph cells.

As to the frequency of these cases, I wrote to Dr. Pfahler some time ago and he wanted to know where I got all these cases. I have two additional cases at home now, under treatment. One child, six months old, weighed only eight pounds,

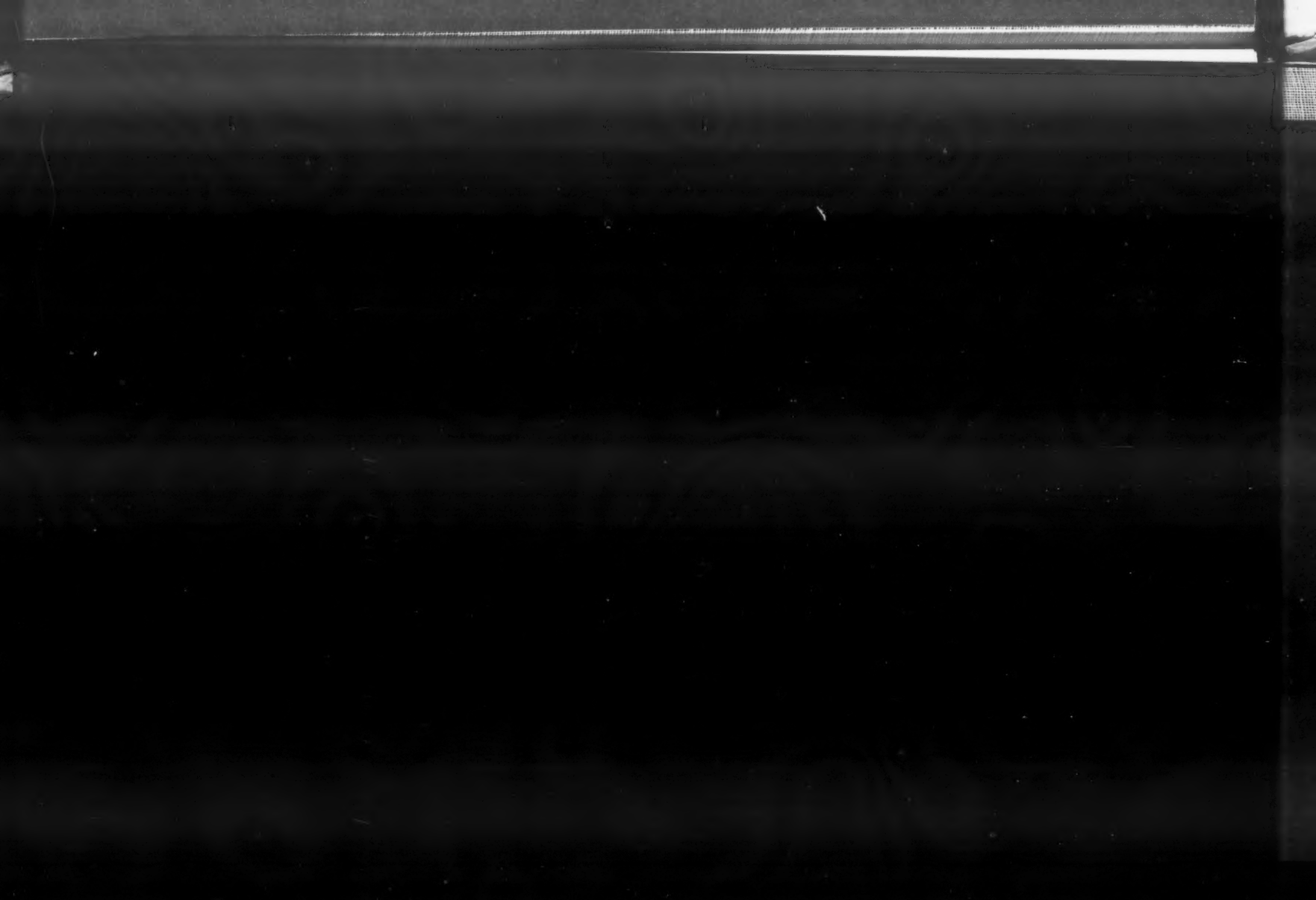
and was still losing in weight. There was inspiratory stridor since birth. It has gained one pound in seven days under treatment, and the stridor is much improved. In the other case I have given only one treatment. I believe that the wards of general hospitals contain many such cases that are operated on for enlarged tonsils and adenoids. These cases are undoubtedly plentiful, but go unrecognized. Some of them succumb to the anaesthetic or die from intercurrent affection. There is a class of cases in which there is hyperthymization. There is an enlarged thymus, but there are no pressure symptoms. There are lymphocytosis, enlarged lymph glands, enlarged spleen and liver. The child has retarded mental and physical development. In one such case the treatment by means of the ray was very favorable. The child progressed wonderfully. There was decrease in the size of the gland, the internal secretion is diminished in amount, and the symptoms produced by the hyperthymization have abated.

After I finished my experiments on the rabbit, I found that Ebert and Bordet, in the Journal of Diseases of the Blood and Heart, recorded experiments on dogs and cats, in which this decrease in the size of the thymus was also reported.

As to the danger of these treatments and the production of toxemia, I have not seen any trace of it in my cases. I do not believe that there is anything to be feared from atrophy of the thymus. It has not been proven that atrophy of the gland will make any difference in the human economy, although in the cases reported the treatment has not been pushed to the point of producing atrophy. Removal of the thymus from dogs has caused obscure changes in the bone similar to rickets. One experimenter recently showed that such dogs will not live longer than a year, but so far as this applies to the human, it has not been shown that life is shortened or interfered with in any way by a reduction in the size, or a partial atrophy of the gland.

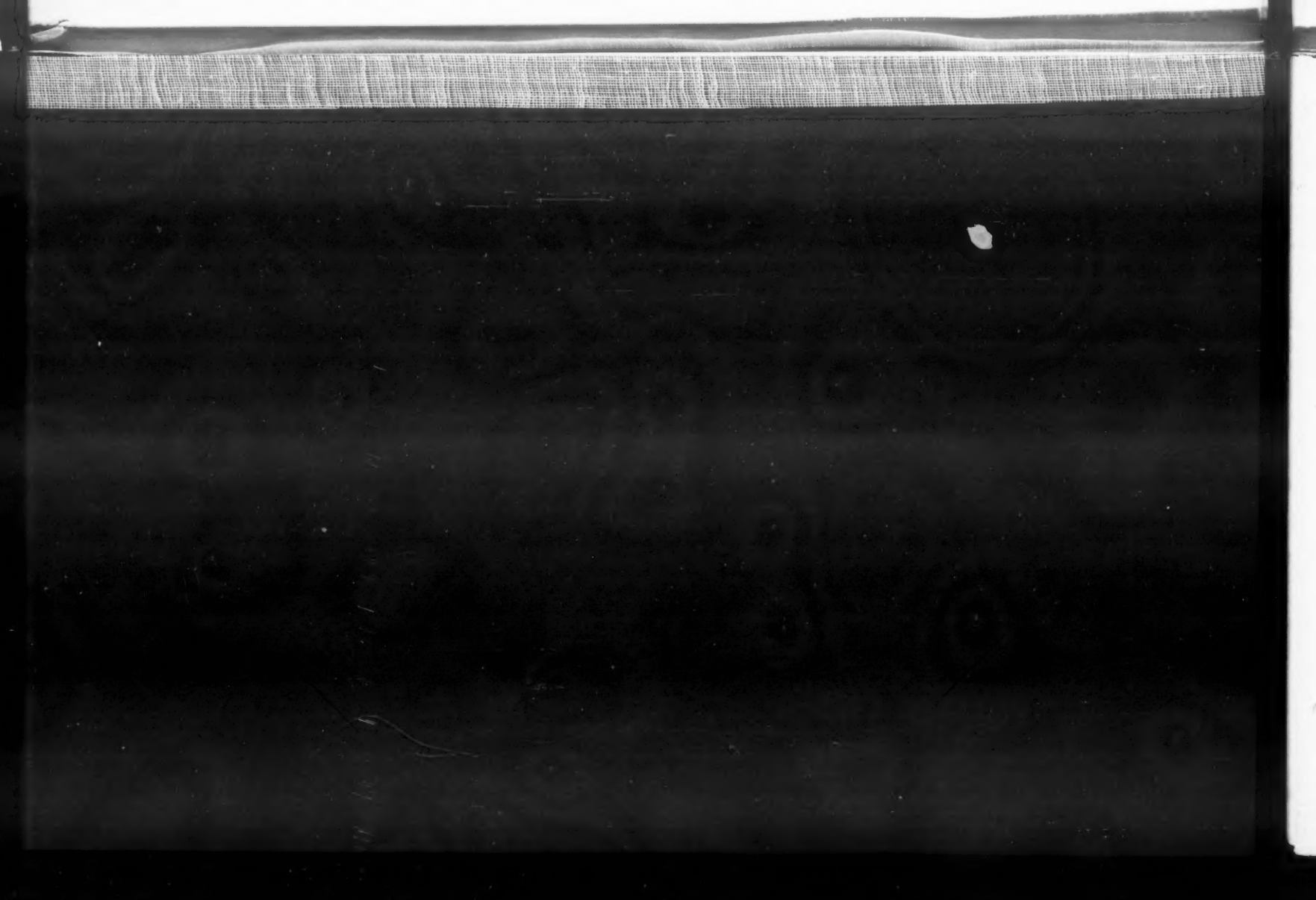
Regarding the diagnosis, I do not believe that you can make a diagnosis from the plate in every case. We did so in two cases. If the gland is enlarged antero-posteriorly,

you cannot get any shadow, and with a child moving continuously, absolute immobility is out of the question. Therefore, we do not try to make a diagnosis from the plate alone, but depend largely on the clinical picture. If dullness extends to the right or left of the sternum, you can safely make a diagnosis of enlarged thymus. If not, then the ray will not help you at all.



GALLSTONE

PLATE BY DR. GEO. E. PFAHLER



DETECTION OF GALLSTONES BY THE ROENTGEN RAY.

BY GEORGE E. PFAHLER, M.D., PHILADELPHIA, PA.

The detection of gall-stones by means of the Roentgen-Ray involves many difficulties:—

1. Their density differs little from the surrounding bile, and with this shadow of the bile we must reckon the shadow cast by the liver, which is also more or less saturated with bile. If the biliary calculi are composed partially of calcium salts, they can be then more easily detected. Therefore, the greater the quantity of bile surrounding the gall-stones in the gall bladder or the liver, the greater will be this difficulty.

2. Biliary calculi occur more frequently in stout people. Therefore, one meets the same difficulties that are involved in examining stout people with renal calculi. The small shadow cast by the stone must be differentiated from the shadow cast by a great mass of soft tissues. In such cases, we are confronted not only with the density of a great mass of soft tissue, which in itself lessens the differentiation of our shadows, but we must contend with the secondary radiation from this mass of soft tissue which by its cross rays tends to obliterate the sharpness of differential shadows.

Therefore, the stouter the patient, the more difficult will be our task, though one must not conclude that the examination is impossible on this account. One of the cases in which the shadow of the calculus was shown the most clearly was a fairly stout woman.

3. On account of the faint differentiation of the shadow of a gall-stone, it is necessary to have the liver and gall bladder absolutely still.

4. It has been shown by a number of men that over exposure or under exposure, even when the stones are laid upon the plate, will nearly obliterate the shadow. A very high or a low vacuum will have the same effect. Therefore, the length of the exposure and the degree of vacuum must be correct.

5. One must differentiate the shadow of gall-stone from that cast by calcified costal cartilages, renal calculus, and fragments of bismuth, pills or other substances in the stomach or bowel.

I felt the importance of the diagnosis of gall-stones very early in my work, and while on duty in the Philadelphia Hospital in 1900 I conducted a series of experiments to determine this possibility. I took from the autopsy room a liver with the attached gall bladder containing gall stones and obtained a beautiful Roentgenogram, showing even the facets in the gall-stones. I took also a large variety of stones and placed them upon a plate, making the proper exposure and obtained beautiful shadows of each variety. I then used two cadavers and inserted the various gall-stones in the gall bladder, sewed up the wound and made an exposure each time. In each instance I obtained a shadow of the stone, but the shadow was only faintly differentiated from the surrounding tissues. At that time the length of exposure (with our small apparatus) was from three to eight minutes.

In the above experiments, I was dealing with an absolutely still body and I knew the stones were there. Therefore, I concluded that in the living subject, where one must contend with respiratory movement, and with the uncertainty of a stone, the rays would be of no value in diagnosis. I repeated these experiments at the Medico-Chirurgical Hospital in 1904 with the same conclusion.

Since the above date, we have gradually increased the power of our instruments so that exposures are made in as many seconds instead of minutes. We have learned how to keep our patients and apparatus still, how to eliminate in part the effects of secondary radiation, how to judge and regulate the vacuum of the tube, and the length of the exposure. In short, we have improved our technique so that today the detection of gall-stones becomes a possibility.

I have never published these investigations because they seemed entirely negative in value. I mention them now only to illustrate difficulties which at that time could not be overcome, but which at present we can master.

1. **Technique.**—The patient should be thoroughly purged. For this I prefer a bottle of citrate of Magnesia. If possible the stomach should be empty. Therefore, I prefer to give a purgative in the evening and make the examination the next morning before the patient has eaten breakfast. In this way one eliminates the confusing shadows due to gastro-intestinal contents. One also reduces somewhat the total bulk of substance through which the rays must pass.

2. **Position of the Patient.**—Having removed all clothing in the line of exposure, I place the patient upon the abdomen with the plate under the gall-bladder region. The arms are extended toward the head so that the patient is resting with the chest, elbows and face flat on the table. The upper part of the body is then bent strongly to the left (not rotated.) This opens the space between the lower ribs, and the crest of the ilium to the widest possible angle, through which the rays can best reach the gall bladder.

3. **Position of the Tube.**—The tube with the compression cylinder diaphragm (Albers-Schonberg) is set so that the rays will pass obliquely through the space between the last rib and the crest of the ilium toward the gall-bladder. By means of the diaphragm cylinder we eliminate many of the secondary rays which in the early days made this work impossible. At times a certain amount of compression can be added, which will lessen the total bulk of tissue, and lessen the distance of the tissue and the diaphragm from the plate.

4. **The Exposure** should be made as short as possible and must of necessity be made while the patient is holding the breath. A little time should be spent in training the patient in holding the breath absolutely still. The absolute time cannot be set, for it will depend upon the power of the apparatus, and upon the skill of the operator who must judge quickly at the time, according to the working of the tube.

5. **The Vacuum of the Tube** should be the same as is used in making kidney examinations, and should register No. 6 to 7 on the Benoist scale. For the purpose of localizing the region, I often attach to the skin a small fragment of lead by means of a narrow strip of adhesive plaster.

Renal Calculus. In one patient who had the symptoms of gall-bladder disease I found a stone in the upper part of the right kidney. This can be determined usually by using the usual technique for a kidney examination when the shadow of the stone will be more distinct and smaller.

Calcareous deposits in the costal cartilages are likely to occur in streaks, to be found on both sides, and not to be confined to the region of the gall-bladder. There is, of course, nothing to prevent the occurrence of both gallstone and calcifications in the costal cartilages in conjunction. In such instance the absolute differentiation is almost impossible. This is the condition in the last case I have examined, and in which an operation has not yet been performed.

The possibility of *artifacts* will occur to every experienced Roentgenologist, but this can be eliminated by a repetition of the examination.

Results.

So far I have only had three cases in which my diagnosis was confirmed by operation. The other patients in which I found doubtful shadows of stones have not been operated upon.

Of the three positive cases, two were sent to me for stomach examinations. In both a preliminary plate was made before giving the bismuth meal. The stomachs were found normal, and this was confirmed by operation. So far, no case has been operated upon in which a stone was found that I did not find. But this must not be understood to mean that I believe that all stones can be shown. This would be far from the truth.

Conclusions.

1. Gall-stones can only be shown when they are composed of a substance of greater density than the surrounding tissue. This will usually mean that they contain some calcium salts.

2. When conditions are favorable I believe that a certain proportion of calculi can be shown, but the positive diagnosis alone is valuable. If a calculus is not found it can by no means be interpreted as meaning that no stone is present.

3. I believe that only those Roentgenologists who have mastered a good technique for kidney examinations can hope to find gall-stones. Careless reports based upon insufficient evidence of imperfect plates will only bring discredit upon Roentgen diagnosis.

4. Too few examinations have been made and confirmed by operation to make statistics of the slightest value. Careful work by an expert Roentgenologist associated with a surgeon who has a large clinic of gall-stone disease would go far to establish the actual value of this means of diagnosis.

DISCUSSION.

DR. LEWIS GREGORY COLE OF NEW YORK CITY.

I have had three or four cases in which gall stones were distinctly shown. One of these was so distinct that I diagnosed it as kidney stone. In another case a well defined "X" was shown in exactly the region of the gall bladder, in several plates. I did not feel justified in making a diagnosis of gall stone on this, but it corresponds very accurately with the markings that are frequently shown in the centres of gall stones when radiographed outside of the body.

DR. FEDOR HAENISCH, HAMBURG, GERMANY.

We ought to be very thankful to Dr. Pfahler for drawing attention to this sort of work again. You all know what an extremely difficult task it has been to use the X-ray for diagnostic purposes in gall-stones. In the past years it has been, so far as I know, a settled matter that you cannot diagnose gall-stones with the X-ray. Most of you have done the same as we have abroad. I have tried to devise a special apparatus to hold the plate, but did not succeed.

I had three positive cases which showed more or less indistinct shadows and which I thought might be gall-stones, as it subsequently proved to be.

The principal thing in the paper seems to be his alteration of the technic. I saw the Doctor make some of these examinations in his office, and it ought to make us all try again, but we must do this sort of work with a quick exposure. As the Doctor pointed out, it is impossible to get the gall-stones while the liver is in motion, but it might be possible that if we take up this work again according to his technic we may succeed in doing something. I did not expect to do anything more with it until I heard of his technic. But even with this new technic, while we may succeed in getting some of the gall-stones, we certainly cannot get them all, and we should not base a negative diagnosis on our work. We know that only a few gall-stones will show enough difference in density between the surrounding gall-bladder and liver to throw a shadow on the plate. It is a very small percentage that will do this. But it is an advantage to get even these few. A negative diagnosis is very unsatisfactory. You can remove gall-stones from the gall-bladder, place them on a plate, expose them to the ray, and yet fail to get any shadow, simply because these stones are of the same density as the chemical on the plate.

DR. HENRY HULST, GRAND RAPIDS, MICH.

I wish to express my appreciation of Dr. Pfahler's work. It is a positive contribution to roentgenography, and it is simple but nevertheless it will prove to be a great thing. I would suggest that placing a marker over the spot where you expect to find a stone is not wise, because it might hide the shadow. If you want to indicate the region of the gall-bladder, why not use a lead diaphragm and have the patient lie on that? Not long ago one of the Mayos operated on a case of kidney stone which apparently was very well shown in the skiagram. The stone was not found, however. The patient was turned over on the back, the gall-bladder opened, and a stone was removed from it. I had the pleasure of diagnosing two such cases about seven or eight years ago. I made the plates with the five-seconds' exposure.

DR. A. M. COLE, INDIANAPOLIS, INDIANA.

What would be the objection to using a lower vacuum tube, but of sufficient vacuum to penetrate the tissues? I have not had an extended experience in this work, but I have heard of a method that someone is using in Chicago in which a very low tube and a long exposure is used, and very successful results have been claimed. It seems to me that if we use a tube of high vacuum, such as we would use for kidney-stones, the rays would be more liable to penetrate the gall-stones and show no shadow.

DR. F. H. BAETJER, BALTIMORE, MD.

I would like to ask Dr. Pfahler how many cases he had and whether any of his patients were operated on in which a diagnosis of gall-stones was made, and how many negative skiagraphs were made in cases where an operation was done and stones were found?

DR. H. E. POTTER, CHICAGO, ILLINOIS.

Most cases of gall-stone disease that are sent to us for examination are cases in which the diagnosis is somewhat obscure. There is right upper abdominal trouble, but the doctor is not sure whether it is due to gall-stones. In three cases which I examined during the last year I obtained shadows which might have been caused by stone in the kidney, in the common duct or in the gall-bladder, because these three structures occupy a space in the body which is easily covered by a silver dollar. Even stereoscopic radiographs do not help us in making a diagnosis. These three cases were operated and they were cases of stone in the kidney, with a complicating infection of the gall-bladder. I believe that the combination of right kidney-stone and gall-bladder disease is as commonly seen as are radiographs showing gall-stones.

DR. CHARLES F. BOWEN, COLUMBUS, OHIO.

We might give the patient a large meal and an hour or two afterwards, when the gall-bladder has had an opportunity to

empty itself of bile, we might get a picture of stone. If we take the picture with the patient in the upright position and the stomach full of food, it would pull the colon down out of the way.

DR. ALFRED L. GRAY, RICHMOND, VA.

I have not been very successful in my gall-stone work, and I used extra compression under the ribs on the right side. In addition to this extra pressure, I have attempted to squeeze the liver below the margin of the ribs, giving it a direction downward and forward more than is normal, thereby thinning out the liver as much as possible. Notwithstanding the fact that I have made what I consider to be very satisfactory radiographs, I have found fifty or sixty in which I was absolutely unable to show any stone on the plate and yet stones were found later at operation.

DR. J. RUDIS-JICINSKY, CEDAR RAPIDS, IOWA.

I have for years tried to find gall-stones and have failed many times. Now, I place my patient in such a position that I can use the compression diaphragm as much as possible, and so get good shadows. I now can make the diagnosis, especially when I use the film, pressing it firmly against the region of the gall-bladder. It seems to me that we can get better results in this way.

So far as shadow of a stone in the common duct being mistaken for stone in the gall-bladder is concerned, we ought to know our anatomy better than to make such a mistake. We know where we may expect to find a shadow of stone in the gall-bladder, and where would be the shadow of a stone in the kidney. Such mistakes should never happen.

DR. PERCY BROWN, BOSTON, MASS.

It seems to me that in these cases we cannot be too careful about securing proper catharsis for two reasons: First, because the shadow which we expect to portray will lie in close

proximity to the hepatic flexure and therefore we must get the colon empty. Second, because so many of these patients are fat, phlegmatic females, with a tendency to sluggishness of the bowel. I should also like to have it said what each man's percentage of positive diagnoses was. Mine is about four per cent. A comparison of notes in this regard would be distinctly advantageous.

DR. EDWARD H. SKINNER, KANSAS CITY, MO.

The diagnosis of gall-stones is very interesting to every roentgenologist, but the sooner we realize that we cannot get a shadow of a cholesterin stone, the better for us. There must be some calcareous material in the stone before it will throw a shadow. Therefore, it is necessary for us to remember that when there is no shadow on the plate there may still be a stone in the gall-bladder, and if the symptoms point to gall-stones we should not make a negative diagnosis. My personal experience is limited to about nine or ten cases in which I attempted to get a shadow. I saw a case with Dr. Beclere, in Paris, which was reported in the Bulletin of the Paris Society. He inflated the stomach with air when he made the skiagraph. The plate showed two shadows, one above and one below, seemingly in either end of the gall-bladder. Those two stones evidently were the only ones that contained calcareous material because between them was a mass of other stones, probably of the cholesterin variety.

DR. FEDOR HAENISCH, HAMBURG, GERMANY.

I cannot agree with Dr. Rudis-Jicinsky that it is so easy to differentiate a gall-stone shadow from a kidney-stone shadow, even if we do know our anatomy. Kidneys are apt to wander about in the abdomen, and the liver may be slightly movable, so that the gall-bladder is not always in the same position where it is indicated on the anatomical atlas. An enlargement of the gall bladder or kidney is quite sufficient to push the stone down out of place, so that we must not let it go out that it is absolutely silly to make a mistake in these cases.

DR. LEWIS G. COLE, NEW YORK CITY.

I had one case in which I was unable to show in the radiograph any indication of the stone. But in these plates there appeared very distinctly a small cross-shaped shadow in the region of the gall-bladder. I did not make a positive diagnosis of gall-stones, but said that there was something there which I could not account for. The patient was operated on and he had a gall-stone of the soft cholesterin type. The nucleus of that stone corresponded to the little cross shown in the plate.

DR. H. E. ASHBURY, BALTIMORE, MD.

During the past winter I had occasion to ray gall-stones outside of the body. I made some artificial bile, as nearly of the same consistency as human bile as was possible. I also filled an artificial gall-bladder with bovine bile and suspended stones in it. This was placed on the plate and the gall-stones showed on the plate as dark spots. We placed these on a plate under the patient and they showed up as black spots. The stones we used were of about the size of a thumb. They contained calcareous material.

DR. PFAHLER (closing).

As to using a soft tube, we must remember that rays must be of sufficient penetration to go through the body. Besides, the terms soft and hard mean nothing. I said that I used rays corresponding to six or seven Benoist. I cannot see how you can use a less strength and still have the rays go through the tissues. I cannot see the advantage of using a soft ray unless we make a long exposure, and then we are likely to burn the patient. The shorter the exposure, the better. We ought to try to make these exposures with the patient holding the breath.

As to the number of cases I have had, I think statistics are absolutely useless. Only those cases that are operated on are of value in this connection, because we cannot tell whether the unoperated cases are or are not positive. The number examined means nothing. I do not even count my cases. I have

probably had forty or fifty, but that of itself is of no significance. People go through life with gall-stones that never manifest themselves. Therefore, the only cases that we should count are those that are operated on and where the roentgen diagnosis of stone is confirmed.

As to making the skiagraph after giving the patient a large meal, the thought is a good one, but it does not work out practically. Massaging the gall-bladder and expressing the bile might help.

Regarding the use of films, I cannot see that they are of any particular advantage, because the pressure of the body against the plate brings it as nearly as you can get it.

As to the experiments made by Dr. Ashbury, placing the stones under the body and then radiographing them, that does not bear any relation to the stones that are actually contained within the body. My experiments were made on the cadaver. I placed the stones into the gall-bladder so as to get exactly the same conditions as we get in the living subject.

PHOTOGRAPHY OF THE FLUORESCENT SCREEN FOR ROENTGEN KINEMATOGRAPHY AND OTHER PURPOSES.*

BY E. W. CALDWELL, M. D., NEW YORK.

The idea of photographing the fluorescent screen is not new, and it is alleged that such photographs were successfully made by Dr. Levy of Berlin, and others, early in 1896. At this time the ordinary radiographic exposures were measured in minutes, and, if we consider that a much longer exposure is required for photographing a fluorescent screen with an ordinary camera than for making a direct X-ray exposure with the plate in contact with a fluorescent screen, it is easy to understand why this interesting experiment was not brought to practical use long ago.

In the "Electrical Engineer" of July 1, 1896, there appeared an illustration showing Bleyer's "Combined camera and sciascope" together with a primitive Crooke's tube and induction coil, arranged in a manner which shows the idea clearly enough, but justifies the suspicion that the experiment was not a brilliant success. I do not recall a single allusion to work in this direction that has appeared in print since X-rays became a factor in practical diagnosis.

There can be little doubt that the successful development of this idea, to a practical working basis, will be an important addition to Roentgen technique. For many years we have had to make our radiographs "life size," and to use photographic plates a little larger than the subject under examination. The expense of the large photographic plates used in examinations of the thorax and gastro intestinal tract is a very considerable item, and especially so, if we make the large number of plates which are frequently desirable in such examinations. If we can obtain the same results by making small photographs of a large fluorescent screen, the saving in photographic materials used for such examinations will

*A paper read before the Philadelphia Roentgen Society, March 24, 1911.

amount to several hundred dollars per day in this country alone.

Another advantage is the greater convenience of examining a large number of small plates grouped together, as compared with looking at a series of large plates, one at a time.

The facility with which these small plates or films may be filed or transported will appeal to every roentgenologist.

By far the most striking advantage of screen photography is that it makes actual Roentgenkinematography possible by the use of the ordinary moving picture camera fitted with a special lens.

Moving picture effects have already been obtained by copying on ordinary kinematographic film, series of radiographs made at long intervals, but representing consecutive phases of a recurring cycle such as, for example, the movements of the thorax during respiration. Rosenthal has succeeded in making as many as twenty radiographs of a stomach during a single cycle, and at intervals as short as one-quarter of a second. Kaestle, Rieder and Rosenthal, in their article* on Bioroentgenography of the internal organs, apply the term "Roentgen kinematography" to this last procedure, and criticise the use of the term by earlier experimenters to describe the moving picture effects obtained by patching together roentgenograms made at proper intervals, but during different cycles.

With full appreciation of the humor of the situation, I venture to point out that actual kinematography necessitates making these exposures with a minimum frequency which is determined by the time of the persistence of vision, and which is at the rate of at least ten per second.

The writer is not aware that any practical method of accomplishing this has yet been published. The question of the practical value of accomplishing this rather difficult feat has been discussed by various writers, many of whom are inclined to the view that it is of little importance. Nearly every one agrees that its chief use would be in the study

*Archives of the Roentgen Ray, June, 1910.

of movements in the gastro-intestinal tract and the organs of the thorax.

For these portions of the body plates or films of rather large size are used, and it will be obvious that the changing of these large plates at a rate of ten per second or faster, will be attended by serious mechanical difficulties. In addition to this the expense of plates or films of such size, and in sufficient number to give a continuous record, for even a few seconds, would be prohibitive. There is also the difficulty of copying these "full size" radiographs on the moving picture film in their proper order and position.

Such considerations as these led the writer, many months ago, to the conclusion that the brilliant work of Rosenthal, although an important step in advance, is still almost as far from actual practical Roentgenkinematography as the earlier attempts which he criticises. The very creditable repetition of Rosenthal's results by Dr. L. G. Cole, with apparatus furnished by Dr. Waite, has brought us no nearer to a practical solution of the problem.

Long ago it occurred to me, and probably also to many of my colleagues, that kinematographic photography of the fluorescent screen would eliminate the difficulties just mentioned. It therefore seemed logical to renew the attempts at photography of the screen, though it was obvious at the outset that many new difficulties would be encountered before this could be made practical.

Since 1896, however, our ordinary X-ray exposures have decreased from minutes to fractions of a second. We now have faster lenses and faster photographic plates, as well as better X-ray tubes and more powerful exciting apparatus. During the last year or two much better fluorescent screens have appeared; and the moving picture camera of today is a practical article of commerce. This rather remarkable record of progress does not bring us to a practical photography of the fluorescent screen for purposes of diagnosis.

The only screens in common use, which give fluorescence of sufficient actinic value are those containing calcium tungstate, but it is reasonable to hope that others may be developed, which will have greater actinic properties, though

they may, perhaps, be less brilliant in the visible portion of the spectrum. This is a problem which seems to me worthy of the serious attention of the chemist.

The experiments to be described here were made with a Gehler folie which, as is well known, has phosphorescent as well as fluorescent properties, and gives off light for several minutes after cessation of the exciting X-ray. To determine whether the persistence of this illumination would interfere with making successful photographs of the screen in rapid succession, I attached a Gehler folie to a rotating disk and subjected it to X-rays which reached it through a very narrow radial slit in a sheet of lead. In a dark room these rays produce a brilliant narrow line of fluorescence on the screen, and it was found necessary to rotate the screen at an exceedingly high rate of speed in order to materially widen the brilliantly fluorescing portion. From this it was readily inferred that the phosphorescence which persisted, was much weaker than the fluorescence which subsided with the X-ray, and that no difficulty would be encountered from this source.

A few photographs were made of fluorescent screen shadows of the human body with an ordinary camera and a Cooke lens working at aperture of F4.5. As was expected, the exposures necessary were many times longer than would have sufficed for ordinary radiographs made with the same screen in contact with the plate. I was delighted, however, to find that these photographs were full of rich detail, and that, as I had hoped, the camera recorded much more than the eye could see on the fluorescent screen. This last mentioned fact convinces me that this method of examination of moving organs will be more accurate than direct fluoroscopy, which is now a generally recognized necessity.

The one thing lacking to make this work completely successful was greater speed. In order to obtain this there are several possible directions for improvement, in all of which a practical limit seems to be reached very soon.

In the first place, a screen of better actinic properties may be hoped for, but improvement in this direction seemed clearly beyond the experimental facilities of the writer. Improvement in speed of the photographic plate was not con-

sidered for the same reason. Much has already been done in this direction, and it will probably be very difficult to surpass the results obtained by Lumiere.

There remain to be considered the possibility of increasing the fluorescence of our present screen by obtaining more intense excitation by X-rays; and of obtaining lenses capable of very much greater speed than those in common use.

The amount that we may increase the power of the exciting X-rays is limited by the ability of the human body to stand such powerful radiation for a reasonable length of time without injury, and also by the fact that our best X-ray tubes would be destroyed in a very few seconds by the electrical excitation to which they are now subjected in rapid radiographic exposures.

Practically all of the powerful electrical appliances now used for exciting X-ray tubes give pulsating currents, the energy of which is not efficiently transformed into X-rays because during a portion of each impulse the current strength falls to a point where the rays have not sufficient penetration for radiographic work, although the deleterious effects upon the skin, and the heating of the X-ray tube continue.

Another disadvantage of the pulsating current is that the focus point on the target is more rapidly damaged by a series of very short and powerful impulses of current than by the same amount of electrical energy expended in the tube by a current which is continuous. This has been pointed out by the writer at several meetings of the American Roentgen Society, and has been fully discussed by Wolter, Rosenthal, and others. It will be obvious therefore that excitation of the X-ray tube by a powerful continuous current will result in a gain in speed, and a reduction of the disadvantages incidental to continuous operation.

I have long waited in vain for some manufacturer to bring out a machine capable of delivering such currents, and several months ago, I began the construction of a device which now gives me practically uniform continuous current of from ten to more than two hundred milliamperes at a potential suitable for exciting X-ray tubes. This is accomplished by valve tube rectification of a polyphase current. The appar-

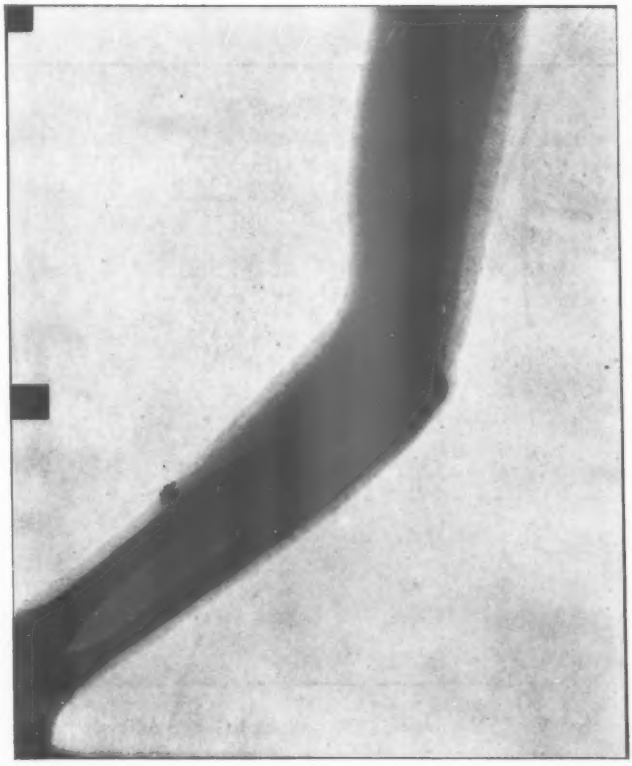


FIG. 1. Enlargement of photograph of the Gehler folie screen. Exposure one second.

FIG. 2. Enlargement of photograph of Gehler folie screen.
Exposure four seconds.

atus will be more fully described in another publication. The performance of this apparatus demonstrates the entire feasibility of producing such currents, and the advantages that were expected from excitation of X-ray tubes in this way.

For kinematographic work, however, still more speed is necessary, and the most apparent method of obtaining it is by making lenses working at wider aperature than those in common use. Inquiry among many prominent lens makers developed the fact that the fastest lenses regularly made work at about F2, which is only about five times as fast as the fastest lenses used in hand cameras.

The photographs shown in the accompanying cuts, figures 1 and 2, were made with a lens working at F4.5 of a 14 x 17 Gehler folie excited by an X-ray tube taking about sixty milliamperes. The exposure for the thorax was about four seconds, and that for the arm about one second. In these plates the detail of the lung is quite as rich as in any good ordinary roentgenogram. In the plate of the arm there is a fair amount of bone detail, the different layers of soft tissue can be differentiated, and the silk sleeve with the hook and eye at the wrist are clearly discernible. With a lens working at F2, I have made equally good plates of lung and stomach in exposures of about one second. I have obtained a plate showing satisfactorily the outline of the heart with an exposure of about one-fifth of a second. These radiographs, or screen photographs, are a little more than an inch square, and would be too small to be readily reproduced, though they are somewhat more brilliant than the other plates shown.

For practical screen photography we need a lens ten or twenty times as fast as the one with which these exposures were made.

With a view to facilitating the design of a fast lens for this special purpose, I induced my friend, Dr. Ernest Blaker, to make a spectroscopic examination of the light from a Gehler folie, in the physical laboratory at Cornell University. As was expected, the light comes from only a comparatively narrow portion of the spectrum, and is most intense at about 5200qq. Some of the corrections necessary in lenses used

for photography with heterogeneous rays, like daylight, will therefore be unnecessary.

Since the object we wish to photograph (the screen) is a plane, depth of definition is unnecessary, and one objection to wide aperture is thus removed.

I have at last found a reliable maker who has agreed to make a special lens having the speed which I have demonstrated to be sufficient for actual kinematography of the Gehler folie during periods of a few seconds, without undue risk to the patient or the X-ray tube.

My inquiries among photographic experts resulted in a premature publication of the general plan of this work. This has led me to bring my results before your society at this time, although I had expected to wait until I could report actual tests with the new lens.

From the results obtained in the experiments described above, I am encouraged to think that photography of the fluorescent screen is worthy of further serious study, and to hope that it may quite revolutionize our methods of X-ray examination of certain organs such as the heart, the stomach, and the intestines, at least.

We shall then have the Schutz-house equipped with a magazine or moving picture camera. While watching the fluorescent screen from this vantage point, we may make a few dozen radio-photographs on a yard or two of film when anything interesting is shown, and thus obtain a record of the motion we desire to study.

DESCRIPTION OF METHOD OF MEASURING FEMALE PELVIS.

BY W. F. MANGES, M. D , PHILADELPHIA.

Out of courtesy to Dr. E. P. Davis, Professor of Obstetrics at Jefferson Medical College, Philadelphia, and for sake of brevity the present communication will be merely technical.

A few Roentgenologists have in the past described methods of estimating the diameters of the pelvis.

Our worthy president, Dr. Pfahler, presented an article on this subject at the meeting in Niagara, fours years ago. His method is far more precise than any the obstetrician has made use of up to the present.

It is difficult to find further literature, and it would seem to be a subject of but little importance. We believe, however, that this deficiency is due more to lack of demand than to lack of value in the methods heretofore, and herein described. The importance of an accurate procedure can not be questioned, since pelvimetry is the foundation of modern obstetrical teaching.

In former radiographic pelvimetry, each patient had to assume a definite and similar position in relation to the plate regardless of contour, or thickness of the soft parts. The rays had to pass in a precise direction.

The method presented here involves two established Roentgenologic procedures, viz., Stereo-Roentgenography and localization by means of the MacKenzie-Davidson cross threads plan or some modification of it. No special apparatus beyond what is necessary for making stereoscopic negatives, and for plotting the cross thread scheme is required, the stereoscopic displacement of the tube serving for the displacement in localization. By the present plan no effort is made to have the plane of the pelvic inlet parallel with the sensitive plate. External contour of the pelvic region can be disregarded, and the rays may pass in any direction that will give a good stereoscopic view of the pelvis. The patient assumes the position of dorsal decubitus, which is comfortable and at the same

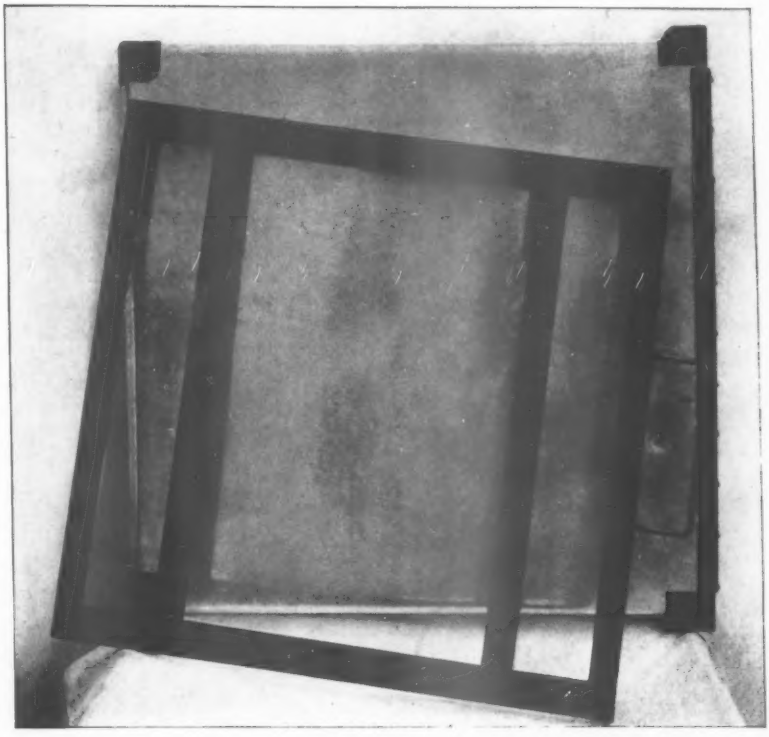
time affords the best position for making stereo-negatives of the pelvis. We can in a general way tell whether we are dealing with a normally shaped pelvis, the simple flat type, or some contracted irregularity. We can tell which is the maximum diameter and which the minimum diameter, but from the stereoscopic view alone no eye is sufficiently trained to accurately measure the diameters without further aid.

We can, however, with pen or pencil mark on the negatives while viewing them on the stereoscope, certain definite points on the shadows of the inner surface of the pelvic brim, the tuberosities of the ischii, the spinus processes of the ischii, and the coccyx. These markings are made to correspond optically on the two negatives and, therefore, can be assumed to be the shadows of single foreign bodies at these points.

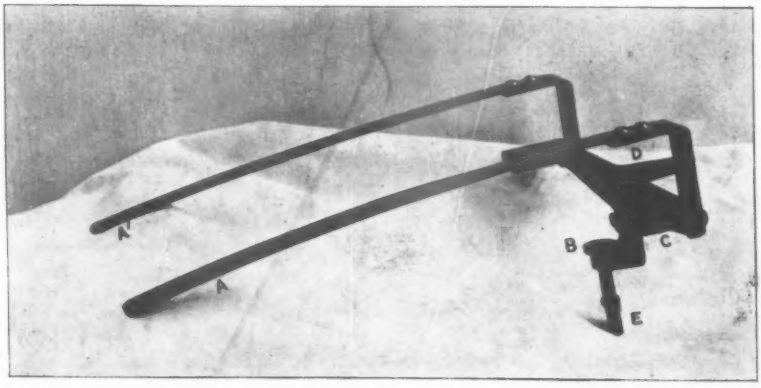
Now we need only localize these imaginary foreign bodies, and measure the distances between them to obtain the actual diameters of the pelvis.

For the purpose of plotting localization we make a tracing on plain white paper of the markings on the two negatives, numbering the tracings 1 and 2 respectively. The plate-holder, table clamp, tube carriage, and localizer are then put in position. The tracing is made to register with the table clamp.

With the two threads occupying at one end the position formerly occupied by the focus point of the tube during the two exposures, the other ends are made to register on tracing one and tracing two of some point on the pelvic brim, e. g. the pubic junction. A metallic point may be adjusted to touch the crossing of the threads, and this represents the actual position of the inner surface of the pubic junction at the time of exposure. By adjusting the threads to tracing one and two of the promontory of the sacrum, we have its actual position at the crossing of the threads, when with a rule or tape we can measure the actual distance between the two points, the antero posterior diameter. In this manner any diameter can be measured. The question of danger to the fetus may be raised, but we think not fairly. Long exposures are uncalled for, since we have powerful generators, extremely sensitive plates and for the very cautious, intensifying screens.

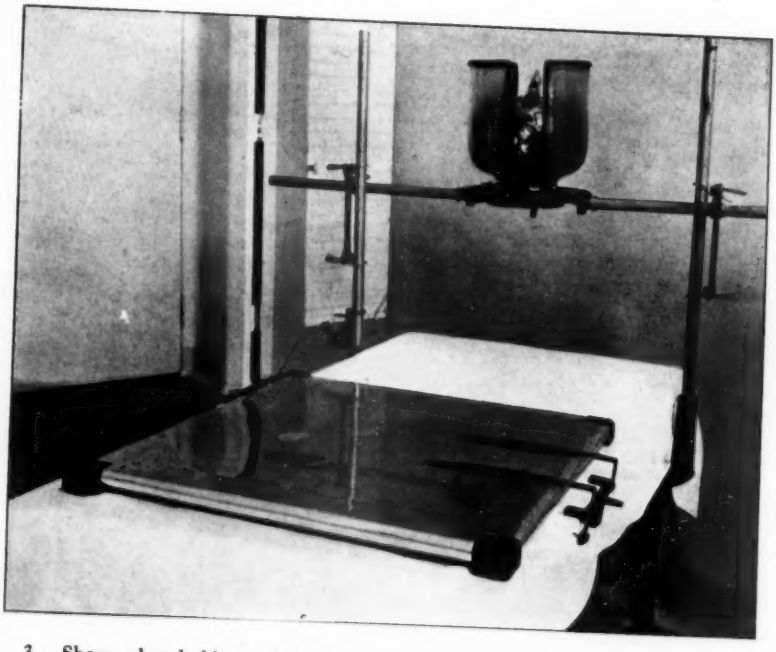


1. Plate Holder. Slide removed and set for 10x12 plates.

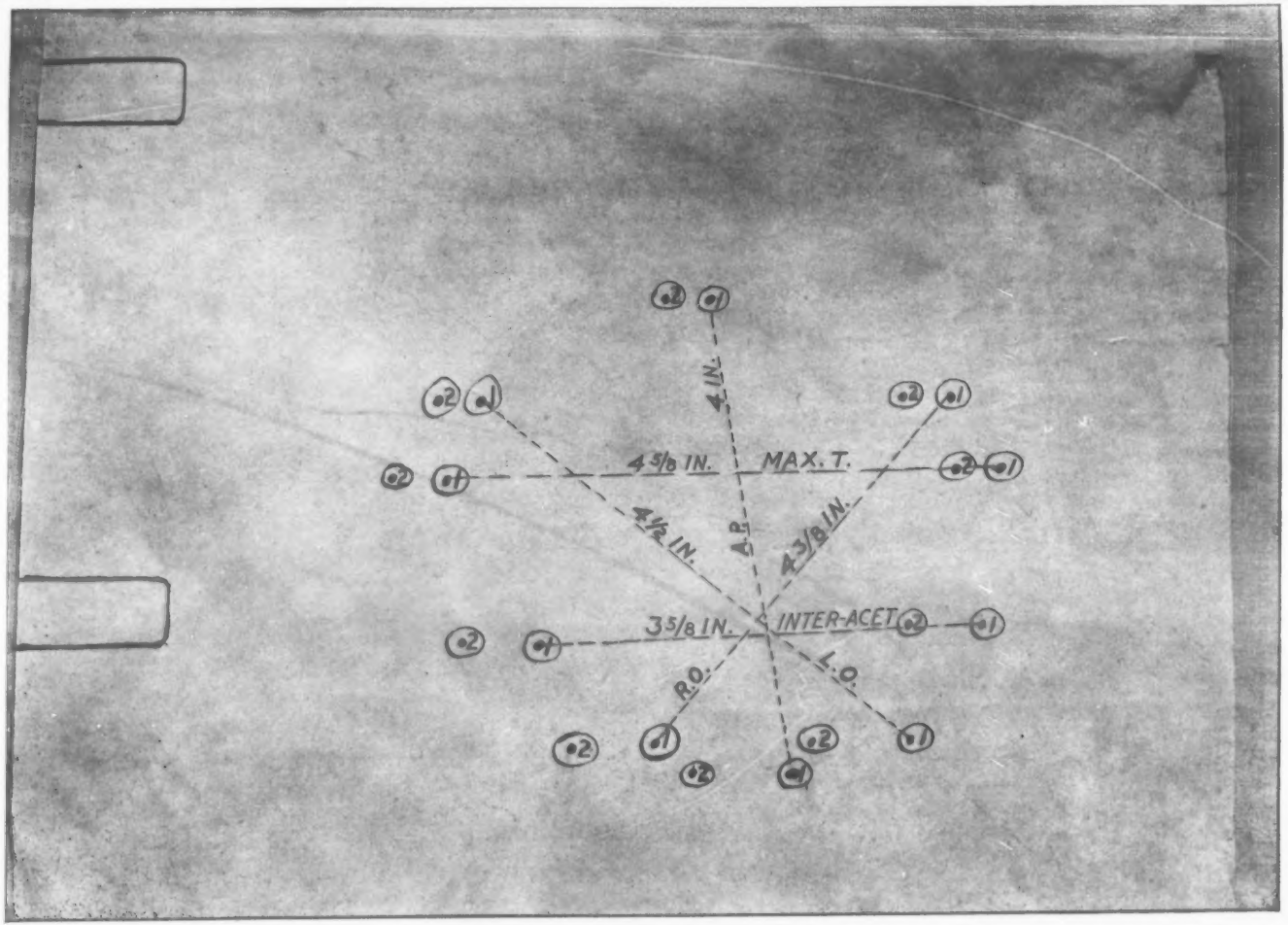


2. Table Clamp. A and A^1, metallic arms which project over plate holder and shadows of which are shown on skias. C and C^1, rest on top of table with B on under surface, clamped by thumb screw E. D projecting externally determines the position of the tube carriage.

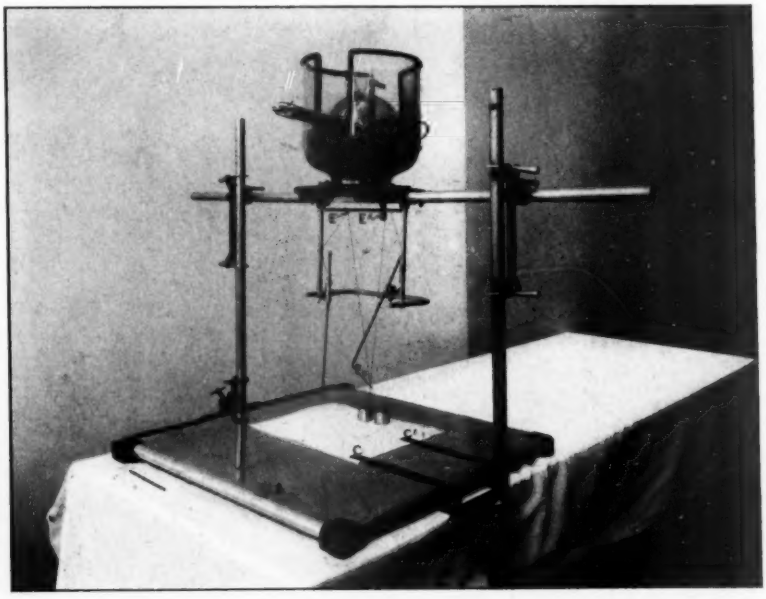
diameter between the two acetabuli.



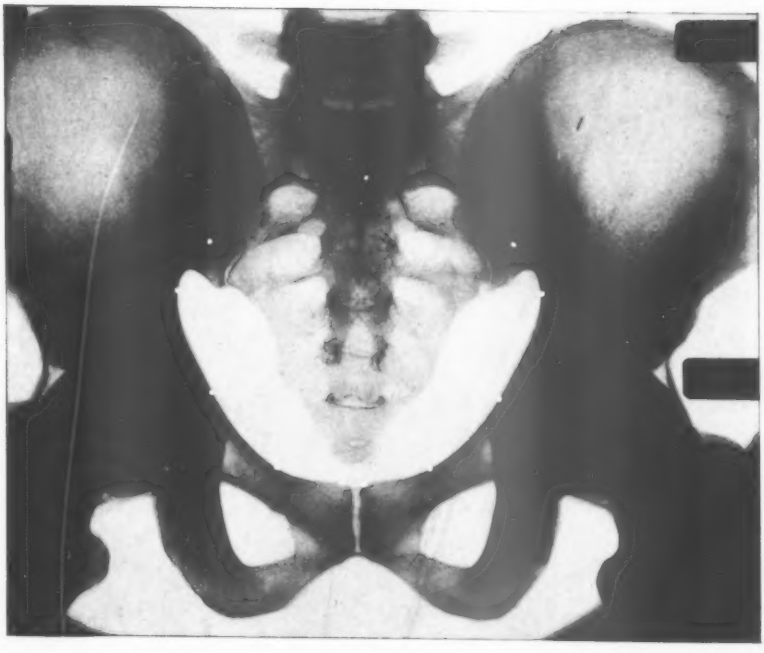
3. Shows plate holder and table clamp applied, and ready to receive patient.



4. Shows tracings from negatives. Those marked 1 inside the rings are tracings from one plate, those marked 2 inside the rings are tracings from the other plate: e.g. 1P and 2P are tracings of the pubes, the most anterior point of the pelvic brim. A. P.=Antero posterior diameter; L. O.=left oblique; R. O.=right oblique; Max. T.=Maximum transverse; and Inter-Acet.=the transverse diameter between the two acetabuli.



5. Shows plate holder, A; table clamp, B; tracing registering with metallic arms at C and C^1; tube carriage resting against external arm of table clamp (its position at time of exposures) at D; localizer in position so that E and E^1 occupy the positions formerly occupied by the focus point of the tube at the two exposures; the other ends of the threads point to tracing 1 and 2 of the pubes; the crossing of the threads represents actual position of inner surface of pubes. The point of rod F was adjusted at the crossing of the threads when the ends of the threads were placed on tracings 1 and 2 of the promontory of the sacrum. Measuring with a rule between this point and crossing of threads as shown on picture by line H, represents actual distance between pubes and promontory of sacrum.



6. Markings on pelvic brim.

7. Stereoscopic view of the pelvis after being marked.

Furthermore, it would require but few generations to educate prospective mothers to resort to such a measure at some preconceptive time.

We would conclude then, that accurate pelvimetry is very much to be desired; that in the method here described we have accuracy; and that with modern equipment, and proper technique the process is free from danger.

DISCUSSION.

DR. GEORGE H. STOVER, DENVER, COLORADO.

I regard the stereoradiogram as the only correct way of measuring, and I am glad that Dr. Manges has emphasized that fact in his paper.

DR. GEORGE C. JOHNSTON, PITTSBURG, PA.

I think that this method of measurement is not only decidedly new, but very ingenious and exceedingly valuable.

FURTHER CONTRIBUTIONS ON THE X-RAY TREATMENT OF LEUKEMIA.

BY HENRY K. PANCOAST, M. D., PHILADELPHIA.

Two thoughts that are apt to arise in the minds of medical men, when, for any reason, the subject of Roentgen therapy in leukemia is brought to their attention, are worthy of our consideration. The first of these is the fact that radiation has usually been found to exert a most profound, striking, and unusual influence upon the important manifestations of this invariably fatal disease. The effect of this influence has usually appeared to be most favorable, at least at first, and at one time it reflected much credit upon x-ray therapy. The second thought which now immediately follows, however, is the fact that, while the x-ray may be the most satisfactory or successful therapeutic agent yet discovered for combating this disease, the gratifying effects primarily produced have been but temporary, and the treatment has invariably failed to prevent the usual fatal termination. Hence any glory reflected in the first thought is lost to us when the second thought becomes uppermost. Furthermore, the latter may lead to reflections upon the apparent limitations of x-ray therapy in this and in other lines, and which may or may not exist in reality. There will always be a tendency among outsiders to draw their own conclusions as to the limitations of Roentgen therapy, unless we, as x-ray therapists, prove our own limitations conclusively by thorough investigations along all lines, and leave ourselves open to no criticism, especially for the reason that advantage rarely fails to be taken of any opportunity for criticism in connection with this branch of Roentgenology.

Let us regard this one instance from the standpoint of an outsider, and consider whether, as a collective body, we have given this particular disease all of the attention it should have received from us, and have done our part in the investigation of both the disease itself and the effects of radiation upon its

lesions, especially when its treatment has, for the most part, been left solely in our hands.

It has been three years since the treatment of leukemia has been discussed by this Society, and that is too long a period to allow such an important subject to lie dormant. The essential object of this paper is to promote discussion upon this topic, and for two purposes, the first of which is to prevent a lack of interest and to awaken a spirit of concerted action toward further investigations. The second purpose is a selfish motive to learn something new from the work and the experience of others. A secondary object is the presentation of a few personal observations of little actual importance made in connection with the method of treatment suggested three years ago in a paper written conjointly with Dr. Stengel.

We had then adopted and have since continued to employ this method, for reasons which may be briefly enumerated as follows:

(1) If we accept the present views concerning the pathology of leukemia, and regard it as of the nature of a malignant disease, with the primary foci in the bone marrow, and the lymphatic enlargements as representing secondary metastatic foci, it would seem more rational to direct the treatment primarily to the bone marrow, with a view of inhibiting further abnormal cell proliferation more directly than is possible by the exposure of the secondary enlargements, which brings about the same effect in an indirect manner through the production of leukolytic substances.

(2) The direct exposure of the bone marrow seems likely to produce a **more powerful,** and does produce a **more lasting,** inhibitory effect than these leukolytic substances.

(3) This direct inhibitory effect tends to prevent or limit further metastasis, so that we are able to leave the exposure of the enlargements until a time when it is comparatively safe to expose these large collections of peculiarly vulnerable cells to direct radiation. Hence the dangerous, and frequently fatal, toxemia so apt to result from the early radiation of the spleen and other enlargements may be entirely avoided.

(4) An early symptomatic cure, which is always likely to mislead, is avoided, and the treatment is less apt to be stopped too soon.

(5) The wider distribution of the exposures is less conducive to burns. The skin should be carefully watched, where adjacent areas overlap, however.

(6) The results so far obtained are regarded as additional evidence of the superiority of this method.

TECHNIC.—Omitting all details that have been previously presented, the treatment has been carried out along the following lines:

(1) The applications are made primarily over the bones of practically the entire skeleton.

(2) Each area is exposed regularly and systematically, and it has seemed advisable, for several reasons, to give each area at least three successive exposures during each series.

(3) Exactness in dosage is essential, especially during the early period of the treatment, when toxemia is readily induced. On the other hand, it is advisable to administer the largest dosage possible without producing the least toxic manifestations.

(4) **Frequency.** Except in cases with severe toxemia, daily exposures are advocated, because of the lapse of time between the exposures of the different regions, and because we are dealing with a wide-spread disease of a malignant character. Two areas may be exposed at one time later on, but this is not advocated at first.

(5) Toxic reactions are harmful, and should always be avoided. Toxemia is an indication for decreased dosage, and not for lessened frequency or cessation of treatment. The difference of a very few milliampere-minutes may be sufficient to induce a toxemia, and even an albumenuria.

(6) Direct exposure of the spleen, or of regions containing enlarged glands, should be avoided early, first, because of the dangers from toxemia; and secondly, because the rapid decrease in leukocytosis that follows is apt to be misleading. The secondary enlargements must be exposed at some time,

of course, but not until a safe period, when they have perhaps decreased somewhat in size, as they are very apt to do without direct exposure; when the leukocytosis has decreased materially; and the improvement in the general condition renders the increased liberation of waste tissue products more readily borne.

(7) Any prolonged periods of rest from treatment are to be avoided, and there should be no let up while there is still any likelihood of good being accomplished.

(8) The duration of the treatment has a **most important** bearing upon the prognosis in favorable cases. Past experience has shown that in every case which has responded favorably, a normal leukocyte count, a reduction of the spleen to normal size, the disappearance of glandular enlargements in lymphatic cases, and a return of the general health to a normal standard—or in other words, a symptomatic cure,—have not in any instance been sufficient to prevent a relapse and ultimate death. Why, then, should we be satisfied to stop at that point? We must certainly treat this as a malignant condition in which recurrence is certain unless every vestige of the disease is eradicated, and we can surely often go farther than a symptomatic cure by keeping up the treatment vigorously until no vestige remains, by not stopping until the differential count shows normal ratios, without which permanent cures need never be expected. We can do even more than this, moreover, by carefully watching the differential count after it has become normal, and starting treatment again at the first indication of any decided tendency toward a reversion to abnormal ratios, which may be taken as a harbinger of a relapse. Experience has shown, in connection with at least one case, that one or perhaps two series of applications over the body at such a time will prevent a relapse, for a time at least. When we have been able to carry the treatment of a favorable case to such a point, which we are, unfortunately, not often able to do, we must acknowledge that we have reached the limit of our present knowledge as to what to do further. A drop in the leukocytosis to a normal or even subnormal count before the enlargements have entirely subsided and the differential ratios have become normal, is a phenom-

enon that is occasionally observed, but one should not hesitate to continue the treatment under such circumstances as long as other indications for its continuance exist.

(9) **The use of arsenic** in connection with x-ray treatment is a question that should be given more careful consideration. Ordinarily there is no objection to the use of this drug in **small tonic** doses during the later periods of the treatment, provided it shows no tendency to disturb the digestive functions in any way. On the other hand, the administration of any form of arsenic in the large doses ordinarily employed in the treatment of this particular disease should be discountenanced, and especially during the early part of the treatment by radiation, and large doses should never be employed in connection with x-ray treatment without due consideration being given to the double destructive effect of these two agents. The effect of large doses of arsenic upon the leukemic cells is much the same as that of direct radiation of the secondary enlargements,—cellular destruction and the production of leukolytic substances, with their inhibitory effects, and also the liberation of toxic products. The toxins so produced, added to those resulting from the x-ray applications, may be sufficient to induce a dangerous toxemia. Furthermore, this effect of the arsenic may make it difficult to properly adjust the x-ray dosage, and it may also lower the leukocytosis too rapidly and render difficult the determination of the effect of the x-ray treatment upon the disease. Moreover, the disturbances of digestion likely to result from large doses of this drug may seriously interfere with the proper elimination of the waste tissue products. Its greatest value, aside from that as a tonic, is in connection with those cases which will progress to a certain stage and then remain practically stationary, radiation apparently being unable to bring about any further improvement. Here moderate doses of arsenic will sometimes materially assist the x-ray toward further improvement in the condition. Also in connection with cases in which, for certain reasons, the x-ray treatment has to be discontinued at too early a period, arsenic is always advisable as a means of retarding the certain relapse and delaying the fatal termination for a time. Such a patient should be ad-

vised to get x-ray treatment whenever it may be possible, even if only once or twice a month.

(10) Cases suffering from acute forms of the disease or acute relapses should not be treated by radiation.

The Prognosis.—The fact that several of our patients have been either physicians, or intelligent lay individuals who have taken such an interest in this rather unusual disease as to study all the literature concerning it that they could obtain, has induced us to be rather guarded in our statements concerning the ultimate prognosis in leukemia, at least when such statements are offered for publication. We all know what the ultimate result of x-ray treatment has been in the past, but it is our earnest hope that we, as x-ray therapeutists, may in the near future have some grounds for promising a far more favorable outcome.

The most favorable result is of course a cure, but we have yet to determine exactly what this term implies in connection with leukemia. So far as we can reasonably assume, a permanent cure implies, in addition to a symptomatic cure, at least an elimination of the cause of abnormal cell proliferation by the bone marrow. The nearest we can come to the cause of the disease, is, perhaps, to say that there is in it, and probably also in polycythemia, either a lack of some controlling influence which regulates normal cell proliferation at such a rate as to maintain the normal ratio between the reds and whites, or there is present some active factor which inhibits or otherwise disturbs this controlling influence. So far as we can reasonably assume in regard to the effect of radiation, the x-ray must either act as a temporary substitute for some controlling influence which is lacking, or must restore some faulty process to normal, on the one hand, or on the other, it must destroy some unknown definite etiologic factor. At any rate, the future prognosis will depend upon what effect radiation can be made to exert upon the cause of the disease.

We do know that so far we have been unable to do more than inhibit the etiologic factor, for so far we have failed to obtain ultimate or permanent cures in our favorable cases.

This may be because we do not continue the treatment long enough to eradicate the disease, as in cases of malignant growths that recur. Otherwise, x-ray treatment would seem to be no more than a palliative measure which affords a prolongation of life for a variable period through inhibition of abnormal cell proliferation.

Regarding the treatment as merely a palliative measure, our experience has proved that the bone treatment offers a longer expectation of life in favorable cases than does the older method; is attended by fewer dangers, and that death is apt to be rather more sudden when it does come, but the patients appear to maintain a fairly good general condition until a short time before death. The general condition usually improves from the start, the patient often being able to resume his usual work very soon, and to continue it for a considerable time. One reason for this, no doubt, is the fact that the early toxemia of the direct splenic and glandular exposures is avoided. The leukocytosis decreases much less rapidly, but this is regarded more as an advantage than a disadvantage. At least twice the length of time, or twice the number of treatments, are required in order to obtain a so-called symptomatic cure, but even this is looked upon as an advantage.

These comparisons are based upon the observations made in connection with the treatment of 20 cases by the method herein advocated. As only 5 other cases were treated by the older method prior to the adoption of the present one, we have included these with the average general results obtained under the older method in making our comparisons.

4238 Pine Street.

DISCUSSION.

MR. H. W. DACHTLER, TOLEDO.

I have treated two cases by this method since Dr. Pancoast published his original paper, and have one patient now under

treatment. I was wondering how long these cases will go without a recurrence. One patient went two and a half years without any treatment. The patient disappeared from observation about six months ago. The other patient is not feeling very well, but has not yet returned because of a recurrence.

DR. ROLAND HAMMOND, PROVIDENCE, R. I.

I spent a little while with Dr. Warthin at Ann Arbor recently. He showed me some slides of kidneys removed from cases of leukemia which had been treated by the Roentgen ray. They showed areas of calcification. He was very pessimistic about the value of the treatment and seemed inclined to consider it of no use, in fact harmful. We ought to settle that point and set him right, if he is wrong.

DR. J. RUDIS-JICINSKY, CEDAR RAPIDS, IOWA.

It is quite probable that the slides Dr. Hammond saw were made from specimens removed from a case of leukemia, but it is also possible that some other condition was combined with the leukemia which would account for the appearance of the kidneys. If the Roentgen ray gives these patients any relief, even for a time only, it is well worth using. I had one such case and the patient came back after three or four years with a recurrence.

DR. PANCOAST (closing the discussion).

Pseudo-leukemia and leukemia should not be confused. They are two entirely separate diseases pathologically as well as clinically. From the therapeutic side, so far as the Roentgen ray is concerned, there is every difference between the two. I am trying to regard leukemia in the light of a malignant disease. Pseudo-leukemia I regard as a sarcoma in my treatment, and I expect a recurrence, yet I treat it as a local disease and not as a general disease, as I do leukemia.

As to Mr. Dachtler's remarks, the particular point I wish to bring out is that we should not wait for the relapse, al-

though it does always occur. Why wait for it? Why wait for the return of symptoms when you can get an earlier sign? Why not watch the differential count? Make a blood count at least once a month for a while anyway. As soon as you see any change in the differential ratio, begin the treatment at once. Do not wait until the patient is nearly dead. You do not do that in any malignant case. Why not treat a case of leukemia on the first suspicion of recurrence, and that is a change in the differential count? That is the important point I wish to emphasize in my paper.

As to what Dr. Warthin told Dr. Hammond, that is an old story. The changes in the kidneys were not due to the effect of the Roentgen ray. They were due entirely to the effect of the toxins liberated by direct exposure of the spleen and lymph glands. By the elimination of these toxins the kidneys were damaged. That is one of the main objects of the bone treatment of leukemia, to avoid that toxemia so that normal kidneys will not be influenced in any way.

THE ROENTGEN TREATMENT OF CARCINOMA OF THE BREAST.

BY RUSSELL H. BOGGS, M. D., PITTSBURG, PA.

Roentgen treatment is given both as a palliative measure and as a curative agent. Although the Roentgen Rays have been used extensively, Roentgenologists differ considerably in regard to the value of the treatment. This is not only due to different degrees of malignancy, in different classes of cases, but also to variations in technique.

Some have given small daily doses with the tube placed close to the surface of the skin, while others have given only few massive doses, with the tube at from twelve to fifteen inches from the surface. Since the technique varies from a few to fifty or more treatments, the physiological action on the tissue will vary from an almost imperceptible dermatitis, without any tanning, to an inflammation of the second or third degree, followed by a sclerosis of the adjacent lymphatic glands. Then it would be natural to expect that various Roentgenologists place the value of the Roentgen Ray in the treatment of carcinoma of the breast at a different level.

In some localities, Roentgenologists were governed or rather were compelled to treat the cases according to the directions of the surgeons who referred the patients. Of course, this did not give the Roentgenologists a fair chance. This is particularly true in large hospitals where the cases have been treated by young Roentgenologists. One Roentgenologist complained that his patients, who were referred by the staff surgeons, told him the time of exposure and the amount of treatments to give in each case. The patients were instructed that they could leave the city as soon as this number of treatments was given. He further states that he realized that in many of the cases no therapeutic effect had been obtained, and for this reason he disliked this particular branch of Roentgenology. It would be as rational for the surgeon to prescribe a definite dosage for his anaesthetist.

Such will not be the case in the future, as both surgeons and physicians recognize Roentgenology as a definite specialty.

In taking up the treatment of carcinoma of the breast it seems advisable to divide the subject into inoperable and recurrent cases and ante-operative and post-operative treatment.

The Rays are the only therapeutic method in inoperable cases that will cause cessation of pain and hemorrhages, disappearance of offensive odors, arrest of invading progress and improvement in the general health of the patient. In a certain percentage of cases the mass is reduced to such an extent that it will become operable. It seems, in the past, that many of these cases which have improved so much were operated upon too early, before the disease had sufficiently localized. When a patient presents herself with the symptoms unfavorable for operation, the mass breaking down, or about to break down, a number of intense radiations should be given, walling off the mass as completely as possible in order to lessen the chances of further infection. Since a large majority of breast tumors are carcinoma, there must be at least two-thirds of the patients that come too late to be in a favorable condition for operation.

It is a well known fact that many inoperable cases who have been suffering from pain and toxemia have been relieved after twenty or thirty intense radiations of these symptoms for a period varying from six months to three years.

I will briefly summarize twenty unfavorable cases for operation, classed as unfavorable because there was extensive involvement of both axillary and supra-clavicular lymphatics together with a broken down mass, or about to break down.

Extent of Disease.	Operation after Treatment.	Result.
I.—Ulcerated mass with axillary and supra-clavicular involvement.	Radical.	Lived four and one-half years.
II.—Large mass in breast with both axillary and supra-clavicular enlargement.	Radical.	Patient died within twenty-four hours.

Extent of Disease.	Operation After Treatment.	Result.
III.—Large mass adherent to skin in breast with axillary involvement.	Would not be operated upon on account of organic heart lesion.	After forty treatments and a severe dermatitis which lasted six or eight weeks, the mass reduced to a small nodular hard lump, freely movable. Patient well, lump still about same size seven years after treatment.
IV.—Both breasts involved with glandular enlargement.	No operation.	Pain relieved after six treatments but no reduction in size after fourteen treatments.
V.—Ulcerated breast with glandular involvement.	No operation.	Mass reduced in size. Ulcer never entirely healed. Patient relieved for six months, died three years later.
VI.—Mass in breast with extensive glandular involvement.	Operated upon after thirty treatments.	Patient lived three and one-half years.
VII.—Mass broke down by a plaster which caused rapid growth.	No.	Healed by forty-five treatments, apparently well for two years. Patient died of epilepsy.
VIII.—Mass broke down by a plaster with extensive glandular involvement, had symptoms of internal metastases.	No.	Healed over after forty-five treatments. Arm remained swollen and was amputated on this account. Patient died two months later.
IX.—Mass in breast with glandular involvement.	Would not consent to operation.	Mass reduced to size of marble after four months' treatment; lump about same six years after treatment.
X.—Mass broke down by plaster; glandular involvement. Had not healed after plaster.	No.	Healed over by thirty treatments, all external signs disappeared except swelling of arm. Patient comfortable for one year. Died six months later.
XI.—Large mass adherent to skin with extensive glandular movement.	Radical.	Patient lived one and one-half years.
XII.—Mass with extensive glandular involvement.	Would not consent to operation after treatment on account of her age.	Mass reduced two-thirds and comfortable for eight months. Died of organic heart disease six months later.

Extent of Disease.	Operation After Treatment.	Result.
XIII.—Ulcerated mass in breast with glandular involvement.	Modified operation.	Patient apparently well three years after operation and treatment.
XIV.—Mass with extensive glandular involvement.	Modified operation.	Patient lived one and one-half years.
XV.—Mass adherent to skin with extensive glandular involvement.	No.	Patient apparently well after three years.
XVI.—Mass in breast with glandular involvement.	Radical.	Patient apparently well one and one-half years.
XVII.—Ulcerated mass with glandular involvement.	No.	Healed over after four months. Patient comfortable for one year. Died nine months later.
XVIII.—Large ulcerated mass with swollen arm and taking morphine to relieve pain.	No.	After forty treatments ulcer healed, patient was comfortable for one and one-half years, made trip to California and died three months later from internal metastases, with no local recurrence.
XIX.—Ulcerated mass with glandular involvement.	No.	Patient weak and suffering intense pain when she came for treatment, three or four treatments relieved pain to such an extent that when unable to come to the office she insisted on having a machine in her home to relieve the pain. Died three months later.
XX.—Mass broken down with extensive glandular involvement.	No.	Ulcer almost entirely healed and pain relieved for nine months. Died three months later.

Every Roentgenologist can report similar cases of inoperable carcinoma and some more extraordinary cases and this proves not only the inhibitory action but that the Rays must be looked upon as a curative agent as well. Never depend on the Rays alone but call in surgical aid even in the inoperable cases, as more can be accomplished with the combination of surgery and X-ray than by either method alone. Now, while there are only five of these twenty cases living today, every one of them was sufficiently benefited to justify the

treatment. The pain was relieved for a period averaging a year, in nearly every case the mass was reduced in size and in some cases it became freely movable. Almost every one of these patients was able to perform her usual duties and be with her famliy, free from pain and from the offensive odor so distressing in ulcerated carcinoma. The patients who died from internal metastases did so without external symptoms except swelling of the arm. As a rule, the patient did not know she was dying of carcinoma. This seems a great deal to anyone who has seen a number of carcinomatous patients with a broken down mass so offensive that it is almost impossible to stay in the room with the patient.

The Rays also have an inhibitory effect on the bronchial and mediastinal glands, but not to the same extent as on disease situated nearer the surface. This is demonstrated by the relief many derive from treatment when external signs of the disease have disappeared. I have two such patients, who know that a cure cannot be expected, and only come when the symptoms become unbearable.

Several surgeons who have operated on cases in which ante-operative Roentgen treatment has been given, coincide with the following statement: If lymphatic nodules were palpable they were found to be small and hard of the type met with in chronic inflammations. The tumor mass is reduced in size. Fibrous elements predominate. It is a well recognized fact that the type of neoplasm more than any other feature influences its course. The more pronounced the cellular and the less the fibrous elements, the greater will be the malignancy. This explains why the atrophic schirrous type is less malignant than medullary adeno-carcinomata. Since Roentgen treatment will increase the stroma or connective tissue and decrease cellular elements it decreases not only the mass but also the degree of malignancy.

A very noticeable and gratifying result of ante-operative treatment is the almost complete disappearance of the normal scar tissue which follows operation. One of these surgeons at the present time sends all his cases for ante-operative treatment as a matter of routine even if there is no glandular in-

volvement. He states that post-operative treatment in the early cases is then unnecessary and that the patient can go to her home without taking any further treatment. Ante-operative treatment has not been carried out in a sufficient number of cases to say positively that it is advisable as a routine procedure. But since the growth can nearly always be reduced and a fibrous wall be formed delaying extension, it seems that in any case ante-operative treatment is allowable.

In recurrent carcinoma where the chest is studded over with nodules the external signs of the disease can be cleared up by Roentgen treatment providing the patient is in a fair physical condition. But if the bronchial and mediastinal glands are involved before radiation is begun, temporary relief with prolongation of the patient's life is all that can be expected.

In cases where recurrence had taken place with nodules studded over the chest and where the arm was swollen, I have been able to apparently cure only four cases although some have lived over three years. Since this is the experience of a number of other Roentgenologists it seems advisable that Roentgen treatment should be given to all these patients. The palliative effects of the treatment should never be denied a patient.

My experience has been that the treatment in this class of cases must be given somewhat more guardedly than in patients who have not been operated upon, as the skin is thin with a lessened blood supply and a dermatitis is more readily induced. When dermatitis occurs it is very slow to heal and the burned area cannot be readily excised as in an unoperated case.

Post-operative treatment of carcinoma of the breast has been adopted by a large number of surgeons as a routine procedure. It is indicated after all operations because more cases are cured and a longer freedom from recurrence is obtained. The treatment should begin as soon after operation as possible as success demands promptness, thoroughness, energy. The treatment should be given with all the severity

the patient's tissues will bear. Inefficient treatment is not only useless but may even stimulate any remaining foci. It is, of course, harmful to push the treatments to such a degree that the skin over the chest undergoes degeneration. One advantage in ante-operative treatment, where there is extensive involvement, is that more intense radiation can be given and then if there is any degeneration of skin it can be removed at the operation. I always give twice as much radiation at a sitting, before operation as after on this account.

After operation there is no need to delay treatment as the healing of wounds, closing of sinuses, covering of granulating areas, etc., are hastened by radiation. A remarkable result of post-operative treatment is the rapidity with which the stiffness in the shoulder disappears. This must be due to the absorption of scar tissue. The scar which is left after operation is almost entirely absorbed. As recurrence very often occurs in the scar this alone is sufficient to justify the treatment. Rodman states: "If anything has been demonstrated it is that recurrence generally takes place in the skin, and its wide removal is the prime consideration, even though the necessarily large wound must be closed by either undermining or skin grafting." As we all know how amenable skin cancer is to the Rays, it is easily understood that any foci here can be destroyed by the Rays.

Radiation should be given over the anterior chest wall in the axilla and over the supra-clavicular glands. It should be particularly strong over the axillary glands and over the clavicle as here the tissues stand intense radiation and the glands are reached with more difficulty. In the past, many have given the longer amount of radiation over the site of operation. The length of post-operative treatment cannot be determined except by the indications of the individual. Sufficient treatment should always be given to produce tanning with a slight desquamation. This will usually require, when using a filter, between twenty and forty treatments of twenty minutes each with the tube placed at about twelve inches from the surface. Roentgen treatment should be given as carefully and as thoroughly as an operation is done. Then only can

the best results be obtained. I am sure much of the post-operative treatment has been given carelessly. One reason for this is that oftentimes patients live in distant villages where they do not have an experienced Roentgenologist and it is impossible to keep the patient in the hospital for a sufficient length of time to secure the proper amount of treatment. A few days ago a surgeon called my attention to two patients to whom I had given Roentgen treatment after operation over eighteen months ago. He said he had expected a recurrence in both these cases within a short time on account of the extensive involvement and that he was positive that only the intense radiation had prevented a recurrence. At present, I am treating a recurrent case who had been operated upon with fifty subsequent Roentgen treatments six years ago. The disease was so far advanced that the surgeon did not think favorably of the operation and expected only temporary relief. In this case nearly all the treatment was given over the site of operation. The recurrence is apparent in the supra-clavicular glands only. Whether there is a deeper metastases remains to be determined. The recurrence is disappearing under treatment. Here is a case where the Rays have proven of great service even with faulty technique. The present day method might have worked a permanent cure.

Early operation and a thorough use of the Roentgen Rays will do much toward doing away with the clinical picture of cancer of the breast, which has been so drawn in past years, as to create a most unfavorable impression on the profession by the laity.

Post-operative treatment certainly makes the operation more radical, as glands can be reached which cannot be removed.

After the treatment and observation of a large number of cases both operable and inoperable, before and after operation or without operation, I concluded that a localized resistance to the invasion of carcinoma is temporarily or permanently established. This is especially true in the milder type of malignant epithelial growths. It is a noticeable fact that the more widely disseminated the less the reaction is produced. This principle may be observed in many of the localized infections.

I. To recapiulate:—Under the influence of the Roentgen Rays, used as a palliative remedy glandular involvement has melted away; ulcerated masses have healed over; adherent tumors have become movable; inoperable cases have become operable; rapidly growing carcinomata have assumed a more schirrous type; lymphatic pathways have been sealed against extension and a fibrous wall has been erected against further growth; life has been prolonged and redeemed from misery. This would seem to call for routine ante-operative use of the Rays even in favorable cases but experience is not yet sufficient to permit us to assert this as a demonstrated fact.

II. Post-operative treatment has diminished scarring, promoted healing, postponed or prevented recurrence.

III. Such results demand not only technical competence, but judgment, clinical knowledge of both the disease and the remedy, promptness, energy and courage.

IV. Surgeon and Roentgenologist must work hand in hand, each availing himself of the other's aid but each respecting the other's authority in his own field and each having a broad scientific understanding of the whole subject.

THERAPEUTIC EFFICIENCY OF ROENTGEN IRRADIATION.

BY GEO. C. JOHNSTON, PITTSBURG, PA.

A perusal of the preliminary program of the 1910 meeting of the American Roentgen Society reveals a decided scarcity of papers dealing with therapeutics of the Roentgen Ray. The reason of this is that the ground has been so thoroughly explored that any paper dealing with the subject must almost necessarily lack originality and therefore to a degree interest also, whereas the field of diagnosis is constantly extending and each year shows some new use for the ray. The preponderance of diagnostic papers over those dealing with therapeutics might lead the general profession to believe that as the field of diagnostic value increased that of therapeutic value had decreased. This is far from being the true status of affairs. Once the truth has been established firmly we cease to affirm it; it is no longer necessary that you affirm the rotundity of the earth. Those whose opinions we care for have accepted the truth; those who have not accepted it are incapable of recognizing the truth when they see it, but there still remains a considerable proportion of the profession who read but little and are out of step with progress, who require to be educated in the value of this agent in the treatment of various diseases.

I have been asked more than once within the month by men otherwise professionally intelligent if it were true that the X-ray was capable of destroying rodent ulcer; it seems to me therefore that it is the duty of this society to spread more widely the truth regarding radio therapy.

There is absolutely nothing new in the few points that I wish to bring before you, but I should like to evoke a discussion which will be participated in by every man here who is doing therapeutic work. Radio therapy has proven itself of value in three classes of diseases: 1st, the dermatoses; 2nd, glandular diseases including leukaemia and, 3rd, malignant diseases.

To the dermatologist who is wililng to devote enough time to the study of this agent to insure its intelligent application, the ray has proven of extreme value. The physiological action of the ray upon the skin is pronounced and constant and all that is necessary to produce exact results is the ability to apply the correct dose at proper intervals or at a single sitting. (I still observe the persistence of the popular self delusion that the Roentgenologist is *per se* a Dermatologist, the Dermatologist a Roentgenologist and the Drug Store clerk a Doctor.)

The glandular affections wherein the ray has proven itself valuable are tubercular lymphadenitis and goitre in all its varieties except cystic. The treatment of tubercular cervical adenitis by means of the Roentgen ray is eminently satisfactory and leaves little to be desired. The results are permanent. A number of cases treated several years ago have never experienced any recurrence but remain in excellent health. Some twelve cases recurrent after one or more operations have completely recovered by the use of the ray alone and remain well today. Patients with multiple sinuses from scattered suppurating glands have cleared up completely with sinuses closed while the cosmetic result in these cases is most excellent. The only unsatisfactory cases encountered have been found in children from four to six years of age, with one or more boggy inflamed glands about to undergo suppuration and accompanied with tonsilar abscess or bad tonsils. Such cases should not be accepted for treatment until after the glands have been drained and a tonsilectomy performed. In a number of instances perfect results have been obtained in patients who had been previously operated upon once or more and given the benefit of sanitarium treatment, tuberculin, etc.

There seems to have been a hesitation among Roentgenologists about undertaking the treatment of the various forms of goitre, a number of men have reported unsuccessful results and but few cases of any kind have been reported. Simple hypertrophic goitre, while quite common, does not fall into the hands of the Roentgenologist until the enlargement of the gland with the resulting pressure symptoms forces

the patient to seek relief. The gland is by this time quite large and its retrogression under radiation necessarily becomes a tedious process and unless the operator is confident in his technic he and the patient lose heart and the treatment is interrupted before sufficient dosage has been given to insure results. Some of these cases require from forty to fifty treatments. The sole reason for treating cystic goitre at all is in the hope of producing sufficient capsule to render the following operation easy.

Exophthalmic goitre is the most satisfactory of all the varieties from the standpoint of treatment if the cases come to observation sufficiently early to permit time to check the hypersecretion of the diseased thyroid by radiation. Some patients are so thoroughly toxic when first seen that immediate operation seems imperative; usually, however, by placing such patients at rest, permitting no physical or mental exercise and pushing treatment with massive doses, encouraging sweating and elimination, dangerous symptoms can be held in check until such a time as the physiological action of the ray in inhibiting glandular secretion, checks the formation of the thyrotoxin. Once the pulse rate begins to decline and the tremor to lessen the battle practically is won and a slow return to normal begins. As soon as the profession discovers the value of the X-ray in the treatment of this disorder, patients will be referred much earlier in the course of the disease, and the same rule will be found to apply here as elsewhere, the earlier treatment is instituted the better the results of treatment.

Personally, I have never experienced any difficulty in relieving all the symptoms and apparently curing early cases of exophthalmic goitre; twenty-four such cases have responded nicely to treatment and four are under treatment at the present time, but patients with marked protrusion of the eye balls, considerable vascular dilatation of the thyroid, marked tremor, profuse sweating, tachycardia, dyspnoea, with a pulse rate of 160 or higher, scarcely able to reach the office for treatment are *not* the class of cases in which X-ray is indicated. Where it is possible to put such a patient to bed and enforce absolute

rest, bedside X-ray treatment may be tried with some hope of success, but the patient should never be permitted to get into such a condition before X-ray treatment is begun, since a few weeks' treatment at the beginning of the disease would have absolutely prevented such unfortunate progress. I have treated two cases of malignant disease of the thyroid by Roentgen irradiation; the first a young girl twenty years of age with a complete sarcomatous involvement of the thyroid, considered inoperable, was given 22 treatments which reduced the gland in size and rendered the case an operable one. Dr. C. Q. Jackson performed a complete thyroidectomy and at last report, some nine months after the operation, there was no evidence of recurrence. The pathologist pronounced the specimen sarcoma. Second case, an unmarried woman thirty-five years of age, referred by Dr. Jackson with malignant disease of the thyroid, was apparently cured, the tumor completely disappearing and it has remained well almost a year; under continuous observation the recurrence expected has not appeared. A number of other patients with malignant thyroids have been declined on account of the progress of the disease and the evidence of dissemination. I am convinced of the extreme value of this method of treatment in these cases, but large doses must be employed and the gland rayed from all sides, filtration by the method of Pfahler being an absolute necessity. Tubes of high penetration capable of passing 1¼ M. A. for ten minutes at 10 inches must be used.

Diseases of the Skin.

The efficiency of the Roentgen ray in the treatment of rodent ulcer, epithelioma, and sarcoma of the skin is recognized the world over and requires no discussion. It is rather pleasing to see that recognition has finally been given to this treatment in the management of lupus vulgarus. Results are obtained in less time and at a less expense than by any other means. Lupus vulgarus requires energetic treatment. I have never cured a case without being compelled to produce a burn. Superficial treatment merely ameliorates the disease and within a year some portion of the diseased area is practically certain to recur. No case in which the mucous membrane was

involved has failed to show slight recurrence from time to time even following energetic treatment but the recurrence has always responded to further treatment. The ability of syphilis to imitate every form of skin disease especially lupus must never be lost sight of. Any case of lupus no matter by whom diagnosed which recurs promptly after clearing up under the ray should be given the benefit of iodide. Lupus erythematosis is usually better treated by carbon dioxide snow.

The value of the ray in the treatment of pustular acne, chronic eczema and psoriasis is well known to all dermatologists. The treatment of leukaemia as outlined by Pancoast and others is worthy of careful attention. Personally, I have been temporarily successful, the first results while often strikingly brilliant have later proven disappointing.

There are a number of varieties of malignant disease that, due to location or other factors are peculiarly suitable for roentgen treatment. For example, the epitheliomas and carcinomas on and about the eyelids. These can be so beautifully removed that close inspection is necessary to show the location previous to treatment. In thirty-one cases so treated failure has resulted in but one and this patient showed a breaking down of the scar one year after apparent cure. The scar tissue simply melted out and a deep clean cut ulcer appeared which would not heal under any treatment. The patient was seventy-three years old and very feeble.

When ulceration has occurred and involved the ocular and palpebral conjunctiva, the prognosis is not so favorable and a number of such cases have shown only temporary improvement.

Rodent ulcer can practically always be cured by energetic raying. A decided reaction is necessary and the quicker the better. Following the throwing off of the resulting scab, a wait of two to five weeks will show whether any further treatment is needed. In any case of malignant disease involvement of the underlying bone, increases the gravity of the prognosis.

The admitted value of the ray in the treatment of recurrent carcinoma of the breast, etc., is the best argument for its em-

ployment before recurrence begins. Post operative radiation should be employed as a routine measure after the removal of every breast for carcinoma or sarcoma. If the axillary and subclavicular glands are involved at the time of operation mediastinal or pulmonary recurrence is a matter of time only, but this time may be much extended by a long course of energetic treatment. When the mediastinum is involved the ray must be delivered from all sides at different sittings as the sternum acts as an efficient shield to the very point necessary to reach.

Many hopeless cases can be given years of comfortable life by ante-operative radiation followed by operation and then the raying renewed. Any man doing this class of work must be satisfied with the temporary inhibition of the disease in a large proportion of his cases but will be rewarded by occasional brilliant results often when least expected. Where the patients present themselves early, before the disease has disseminated throughout the lymphatics, a course of ten to fifteen treatments followed by a radical operation going wide of the disease using no suspicious skin in the flaps followed by three months' post operative treatment is the course always recommended and the results are usually satisfactory.

What is most needed at present is the education of the general practitioner in the recognition of early forms of malignant disease so that the surgeon and roentgenologist may have a few hopeful cases to treat instead of the class of desperate cases so frequently seen at present.

ROENTGEN RAY THERAPY AND ITS PRACTICAL APPLICATION IN MALIGNANT LESIONS.

BY DR. J. RUDIS-JICINSKY, CEDAR RAPIDS, IA.

Every Roentgenologist knows, that after several sittings and exposures of epitheliomata, cylindrical-celled Carcinomata, Carcinomata simplex and flat celled Carcinomata, changes take place in the lesions proper with various metamorphoses or degenerations, pointing to the fact that the Roentgen rays, having the selective power for diseased cells, especially in some individual cases, are of objective therapeutic value, and if nothing more, used properly and in proper dosage, will give subjective results in every malignant case whether they are combined with operative procedures or not, because they at least relieve the suffering of the patient and prolong life. In some cases when the Roentgen rays were administered over a sufficient length of time, the results were very promising, and we have many cases on record of epithelioma especially, which after an elapse of five or six years are still doing well, and even some inoperable deep cases and those of Carcinoma Mamae under this treatment progressed well and no metastases and autointoxications took place, the prognosis being comparatively good. And, strange to say, as you all certainly have observed in your practice, these promising conditions happen in all those lesions rayed, where the electro-chemical action of the rays is complete and the intercellular tissue in the lesions exposed becomes so abundant, as to nearly obliterate the cellular elements, the hard portions of these carcinomata becoming softer or even liquefied and honeylike discharge or exudate demonstrates itself at all points of sloughing, undergoing spontaneous cure perhaps in this way. In that respect we have all the same experience, I am sure, even in fibro-carcinomata, but not so in carcinoma molle. And again, we seemed to have better changes in deeper colloid carcinoma, myxomatodes and melano-carcinomas.

Having a honeylike substance in nearly all the open lesions, which progressed favorably, and reading the reports of others

on the same subject, I have carried out a number of experiments to see if I could cause a certain reaction, or hasten the process of absorption under the Roentgen rays with the help of this seemingly healthy exudate which has some very active properties.

First I have implanted under the skin this honey-like exudate from the human cancerous lesions into the tissues of rabbits and guinea-pigs. Relatively large quantities of this substance were planted under the skin into healthy tissues of these animals without causing any symptoms of reaction, and only in three cases out of twenty was there local infection, which did not amount to very much; but if a very small quantity of such a substance of cancer of a rabbit was inoculated into the tissues of old rabbits or those suffering with any wasting disease or injury, very definite symptoms were produced. The temperature arose from one to two degrees F., at once, and this rise was accompanied locally by inflammation. This process was observed for a length of time carefully and microscopically. The basement substance of various layers of connective tissue, and especially the walls of the blood vessels, became swollen and thickened by their conversion into a translucent, firm, glassy, yellowish material, albuminous in character. The parts of the lesion felt larger than normal and had a peculiar dull shining appearance. Some direct transformation of the tissues progressed rapidly, the parenchyma cells undergoing atrophy, as the result of pressure from the swollen, degenerated tissue. Around each localized lesion produced, was an area, more or less marked, of heat and redness, and with the increasing congestion we had later a casting off of pieces of necrotic tissue, a humor being formed, the cells of which, advancing in the periphery made their way through the lymph spaces and formed new foci. In some cases metastasis followed in the distant part of the body, or general. And these secondary tumors being similar in structure to the primary foci differed in vascularity, abundance of stroma and shape of the cells, but nearly all of them seemed to be rapid in growth, if irritated in any way.

When this condition was recognized the Roentgen rays were employed at once, and the animals exposed individually for 15 minutes, first every day for two weeks, and then three times a week, and following the reaction we finally healed all the primary lesions produced, but the lesions of secondary character, even where the cells presented only the general characters of the epithelium of the part in which they occurred, varying much in this and other respects in every case, did not behave in the same way. We operated quite a few of these lesions once or twice, as the cases required, continuing the use of the Roentgen rays, but the final results were not satisfactory at all, though the animals did not seem to suffer much pain. As a last resort, knowing that phagocytes are disseminated after an irritation in these lesions, we have applied the honeylike exudate, produced in the primary lesions direct to the malignant tumors of secondary character, or reinoculation of the disease in the same animal, and to our astonishment found that the sloughing progressed more rapidly and with better results, the effect of our raying being more promising with every exposure. This discovery was made use of in human beings as soon as possible, and the secondary lesions of malignant character studied side by side with those which seemed to be primary. Fortunately, in spite of all our precautions, the honey-like exudate was employed in some of the cases of animals without regard to proper dosage and strength and the results were nothing short of disaster, the guinea-pigs especially dying quickly, in spite of all the treatments with Roentgen rays and absolute cleanliness of the lesions proper. The honey-like material taken directly from a carcinoma mamae was introduced into an open and healthy wound near the Radial artery and the wrist of the right hand of the experimenter himself, and the actual progress was watched carefully. Our condition being otherwise very good, no specific reaction was caused in the beginning of the introduction of the material in the wound produced. Simple infection followed and with the increased knowledge of the behavior of similar primary lesions in rabbits, we have waited for some secondary demonstrations later on. . . .

All the symptoms of infection manifested themselves, but not a cancer, the swelling of the whole hand was marked, and suffering with all the pain possible could be traced especially to the enlarged glands in Axilla. After an elapse of ten days some exudate and pus material formed in the wound, which I had kept not only clean, but open, and was removed and collected in a special vessel, the pain being relieved every day with the exposure of the original wound to the Roentgen rays, which seemed to raise the resistance of the body against the infection. With the relief of pain the swelling went down comparatively soon, the wound healed, and the human exudate and pus were used to see if we could produce more disturbance of secondary character in those rabbits still alive suffering with primary lesion. And, strange to say, all the rabbits so treated gave no reaction but suffered with very virulent local lesions, if the cancer was irritated, and died later, giving us a complete microscopical study of fatty, colloid, mucous and amyloid degenerations with ulcerations, hemorrhage and all the symptoms of prolonged irritation and this followed by inflammation. In two cases we also had enlarged remote lymph nodes, and the lesion proper healed, the nodules remaining for months. In my case the original local wound healed and the nodules in the Axilla and over the Pectoralis muscles on both sides remained, after an elapse of five years. One thing is sure, that the honeylike exudate in cases of carcinoma I am using up to the present time in a very simple way did produce more necrosis and more rapid sloughing and destruction of the diseased tissue of low vitality in the same carcinoma proper. I do not wash this material away, but take a clean brush and apply the honey-like exudate from one portion of the lesion of the patient to all the portions of his cancer, which do not degenerate quickly enough and am raying the whole. The amount of this exudate to be applied to the other parts of the same malignant lesion to hasten the resolution, absorption and sloughing varies according to the individuality of the lesion, the age, the personal characteristics and general condition of the patient, the type of carcioma, whether primary or secondary, its duration, extent and the severity of

systemic infection. Something may be accomplished by this local treatment with the patients' own exudate and general Roentgenization around the lesion, but to use and transfer the exudate to others is not satisfactory.

This way the whole volume of blood of the patient with an otherwise strong body and with plenty of resistance as far as yet, if we start in time, dilutes the toxic stimulants and more is required to cause the increase and production of those fighting particles and corpuscles, as they are floating in the serous fluid mentioned above. The corpuscles seem to be identical with the white corpuscles of the blood; they appear to be derived chiefly from the blood by a morbid migration of its white corpuscles, although it is also very probable that some of them are derived from a later proliferation of the connective tissues, or other changes in the cells during the inflammatory process. If we examine carefully the exudate we will find that it is a fluid produced as one of the consequences of repair in inflammation. And taking the history of an original irritation in nearly every case and its results of malignant character into consideration, the alkalinity of the exudate, it being rich in potash, its serum albumen, fibrinoplastic material, casein, myosin, lecithin, cholesterin, leucin, etc., we at once will grasp the opportunity for a better chance for repair at the focus of infection, as the blood being charged with its own fighting material and circulating under the Roentgen rays more freely will give us a better local action, the charged cells eliminating themselves after a certain time and definite cicatrization occurs. I do not claim any priority in this study of mine, but would like to state that nearly all the cases of malignant lesions which came under my observation in time, some of them even after operative procedures, progressed very favorably under the Roentgen rays, with proper dressing locally as suggested, the exudate being one of the helping principles.

Observing the cells, and watching the progress of the degeneration of the lesions microscopically, I have not found any evidence of parasites and comparing the results with similar results in the vegetable cells of perfectly healthy cherry trees

of the same age, same quality and same sort as planted in my own garden, may say with others, that there were neither any signs of bacteria. After an elapse of four years of constant irritation to the lower portions of the trunks of these trees done unintentionally with the lawn-mower, I observed new growths on all the trunks, and made slices for microscopical examinations. The proliferation of the cells was identical with that produced by irritation in human tissues and the changes at the site of the lesion were of the same character as the inflammatory process in human tissues, and to make the object still more interesting, the process of repair seemed to be just the same, Nature trying to help along in these peculiar tumors of the trees with an exudate yellowish and perhaps only of a little different composition. Trees without this exudate simply succumbed. My own favorable impression of the influence of this exudate has been principally formed by noticing how rarely the disease seemed to progress by the usual exacerbations and elapses in patients who were tolerating progressively increasing doses of the Roentgen rays, giving us more or less of the exudate in the lesions attacked, and in watching very weak and cachectic cases who were running slowly but steadily in a downward course, in spite of all the treatment.

I do not say that this exudate, CO_2 snow in some superficial lesions, or our Roentgen rays and even in some cases the Radium introduced right into the lesion itself are the specifics found for the cure of cancer, I do not claim to have discovered something altogether new, but I do claim according to my own experimentation, research and the results of actual treatment of hundreds and hundreds of carcinomas and other malignant lesions, that if only one life was saved and all the others did not suffer the excruciating, shooting pains of cancer proper on account of our treatment and their life was prolonged for the benefit of their families, and sometimes the whole of society, even public welfare, that I should be content as we all may be in thus working on and on towards the progress of our knowledge, science and art of healing. . . .

On the other hand, if we transplanted very tiny pieces of skin from embryo rabbits under the skin of twenty other rabbits selected, and after an elapse of two weeks implanted under the skin of each of these healthy rabbits this cancer exudate or direct grafts, cancer never developed. It was the same with those where the blood was mixed in the healthy rabbits and red blood corpuscles, not serum, injected. The inoculation or grafting with cancer was impossible as in the case of a guinea-pig, where the healthy spleen was removed a little piece of the same being introduced right under the skin of the same animal. We cannot assert, that by the use of these and similar methods, we can cure carcinoma, but they tend to support the theory that it can be prevented.

Conclusions.

Carcinoma of whatever character or form, any malignant process in animal or vegetable tissues, is not due to any parasite, or any bacteria, but is a special virulent inflammatory process due to constant or certain irritation of the cells of different tissues, which by this irritation, or from other causes, are then of low vitality, being weakened and the circulation of the blood in them impaired. It cannot be transplanted from one species to another, the growth and spread of implanted cancer may be checked and the heredity is an almost negligible factor, the lesions being preventable.

Roentgen rays having selective power for such irritated and weakened cells especially, in some individual cases, when given in time, will give us objective and subjective results. They will prepare the field of infiltration for operation and in every case of malignant character relieve suffering and prolong life, and in the most desperate cases not only the pain, but also the odor of the discharge is checked right from the start and the patients are comfortable, even able to some extent to attend to their social duties. The electro-chemical action of the rays produces a yellowish, honey-like exudate in the open lesions proper and the treatment has robbed death from cancer of its horrible, painful and offensive elements.

To ray before the operation and after, to prevent recurrence is the safest procedure, because the infiltrated lymph channels

and glands will be converted into fibrous cords and knots, which become the safeguards against systemic infection during the operation and after.

Primary lesions, or those of early stages, with surgical removal, if necessary, give the best satisfaction, best chances of permanent cure in time both before and after operation. In secondary lesions we are not certain of success, but even here we get the subjective results mentioned above.

By actual tests and experimentation it is proven beyond doubt, that the Roentgen ray treatment does not, and according to the absorptive and local action of electrochemical character cannot, cause metastases and internal involvement, but on the contrary prevents them, having most promising effect upon the tissue cells suffering under the special, malignant inflammation.

Even in inoperative cases in an advanced stage, and deep lesions if the resistance of the patient is good, the Roentgen rays may give us comparatively good results.

The sloughing in an open lesion will progress more rapidly and with better results, the effect of our raying being more promising in the most terrible case, if the exudate of the lesion is applied to those portions of the same, where the fighting material for repair of the cells is most needed for obliteration of the diseased cellular element, liquefaction of the same or absorption and degeneration occurring.

Every case has to be watched individually; the susceptibility of the patient, the age, the local lesion, the personal characteristics and general conditions of the patient, the type of carcinoma, whether primary, or secondary, its duration, extent and severity of systemic infection all taken into consideration.

DISCUSSION ON PAPERS BY DRS. BOGGS, JOHNSTON AND RUDIS-JICINSKY.

DR. W. F. MANGES, PHILADELPHIA, PA.

I want to support Dr. Boggs in his views as to the ante-operative treatment, for the reason that one of the best surgeons in this country has found it valuable. It is becoming the custom of surgeons to refuse to operate in carcinoma of the breast. They consider such a case inoperable very much earlier than they formerly did. One of our Philadelphia surgeons, Dr. Gibbons, expressed himself rather forcibly along this line not long since. He said that when one can feel an enlarged gland in the axilla, the case is inoperable. He advises that in such cases every surgeon should refuse to operate, because of the wholesome effect this would have on future generations. The result will be that every woman having a lump of any size in her breast will promptly consult a surgeon and insist on its removal. Dr. Gibbons advises, further, that if enlarged glands can be felt in the axilla, the patient should be placed under the care of a competent roentgenologist, and that the treatment should be given for as long a time as he sees fit. If, in the opinion of the roentgenologist, the case becomes an operable one, then operation should be done.

MR. H. W. DACHTLER, TOLEDO, OHIO.

I have been very much interested in these papers because I have been doing some work in that direction. I have not had much experience with ante-operative treatment, but we know what is the course of this affection, and I do not believe we are justified in postponing operation. I have abandoned the method advocated by Dr. Gray of giving a heavy treatment just before the wound is closed, for the simple reason that the effect we desire to gain, that of blocking the lymphatics, cannot be achieved in one treatment. Furthermore, I do not be-

lieve that we are justified in keeping the patient under the anesthetic for twenty or thirty minutes longer than is necessary.

I especially want to commend the filter devised by Dr. Pfahler. It is a great help, one of the greatest helps we have in the treatment of these cases of cancer of the breast after operation. I usually commence to treat these cases the second day after the operation, or just as soon as I can get the patient to the Roentgen room. I give treatments every day, heavy treatments of fifteen or twenty minutes' duration, and after two and a half or three weeks I feel sure that I have secured enough results to allow the patient to go home, with instructions to return in ten days or two weeks.

I give them such a heavy treatment that there is produced sufficient inflammation to cause a blocking of the lymphatics. I think we should be careful to contribute something to the systemic effect of the Roentgen ray. I have seen patients who reported that they were gaining all the time, and yet I knew they were losing. I have never been able to determine by experimentation on a healthy person that any such result could be obtained.

DR. HENRY K. PANCOAST, PHILADELPHIA, PA.

I want to call attention to a post-operative case of carcinoma of the breast which I treated recently. The great difficulty in these cases is to give tangible proof of the efficacy of the ray. We all feel that we get good results, but we cannot prove that these cases would have remained free from a recurrence had the X-ray treatment not been given. As proof that such post-operative Roentgen treatment in mammary carcinoma does do good, I will cite my case. The patient was operated on and the operation was a radical one. The breast was removed and the axilla was cleaned out, but the supraclavicular region was not invaded. Roentgen treatment was begun soon after the operation. I think the usual number of treatments was given—thirty or more. The patient was discharged with the advice to return in three months. She returned before the expiration of that time, very much disap-

pointed to find a ring of recurrent nodules, extending from the level of the posterior axillary fold around almost to the sternal line in front. On examination I found that these nodules were entirely outside of the area of exposure, proving, I think, that the Roentgen treatment prevented a recurrence in the area exposed. There undoubtedly would have been a recurrence in the scar if the Roentgen treatment had not been given. These nodules are inoperable. But I am treating the patient now and they are decreasing in size rapidly.

DR. D. R. BOWEN, ROME, N. Y.

I have had very little experience in the treatment of these malignant tumors of the breast. I have many more cases of exophthalmic goiter to treat and I presume that I should have reported them before this. In the earlier cases the treatment was too conservative to make a report of any value. In the last three cases I carried the treatment to the point of producing a slight dermatitis. In every case there has been great symptomatic improvement, and in no case have I been able to see any diminution in the size of the gland.

DR. FEDOR HAENISCH, HAMBURG, GERMANY.

I would like to know what dosage Dr. Boggs gives in his ante-operative treatment; also how much he gives and how long the treatment is continued. Then, I would like to know whether he takes always every bit of the skin exposed, because we have often found that operating on X-ray skin is rather dangerous. The stitches will not hold.

I would like to ask Dr. Gray what he means by a series of post-operative treatments. We make it a rule to measure the doses by some definite method because it is useless to say twenty minutes or fifteen minutes every day, or three times a week. We must know the exact dosage, for how long it is applied, and how often. We must have some better means of measurement. I have found in my work that using one or other coil I get an entirely different amount of the rays.

DR. W. C. HILL, CLEVELAND, OHIO.

I would like to mention a few cases of papilloma of the larynx. One of them was a tumor an inch in diameter. It diminished in size rapidly and in about six treatments it entirely disappeared. Unfortunately, it recurred. Later on I treated another case through the skin of the neck and got the same result. In the first case I treated the tumor through the trachea.

DR. GEORGE E. PFAHLER, PHILADELPHIA, PA.

I am extremely interested in the therapeutic value of the Roentgen ray, as you know. I am sure that we are not speaking or writing enough about our results. I am more enthusiastic today than I have ever been. I am getting better results from my work and they are more permanent. I get them more quickly and with more certainty. I measure the dose very accurately, and therefore radiotherapy should progress and not stand still or recede.

As to ante-operative treatment, I suppose we are on safe ground if, when we speak of ante-operative treatment, we confine our remarks to those doubtful cases, the class of case to which Dr. Manges referred, and which Dr. Gibbons says are inoperable. It is in these cases that the glands in the axilla are involved. I think it is in that class of cases only that we are ever justified in recommending ante-operative treatment. The same cause that is responsible for the enlargement of the glands in the axilla has also produced an enlargement of the glands in the mediastinum and elsewhere, and I think that ante-operative treatment is useless in these cases.

A patient came to me with the entire breast involved by an ulcerating nodular malignant mass. The case was considered inoperable. I treated the patient until all signs of the disease had been reduced to a removable scar, one inch in diameter. The scar was removed and the patient is today perfectly well. So that I am convinced that in such cases Roentgen treatment is the correct thing, but we must work with the surgeon and not let him say to us to treat the patient for a week or two, after which he will operate. There must

be every evidence that the disease has become localized. Unless localization has occurred the patient is not ready for operation.

Regarding the open wound method, I agree that it is not justifiable to keep the patient under the anesthetic any longer than is absolutely necessary. I agree further that the disease is just as likely to have extended beyond the wound, and therefore we are not going to reach it any better while the wound is open than we will afterward. Furthermore, the bandages and dressings are in the way. That is not a good procedure, because there is the risk of infecting the wound and of causing an explosion from the spark of the tube in the ether-laden atmosphere. These things must be kept in mind.

As to post-operative treatment, it must be given with the understanding that there is disease there. If there is no disease there, then there is certainly no reason for giving post-operative treatment. The mere fact that we resort to post-operative treatment implies that we think that there is still some disease there, some cells or nodules that have not been removed by the knife. Unless we recognize that fact, post-operative treatment is not justified.

If you give post-operative treatment, the dose must be sufficient to remove that disease, therefore we must not lose time by giving small treatments at long intervals. I have had surgeons send patients to me with instructions to give two or three treatments, and then let the patient go home. That is worse than doing nothing. I treated one post-operative case in which the disease had been very extensive. The supraclavicular glands had been removed as well as the axillary glands. I treated the patient, and a year afterward she seemed to be perfectly well. Suddenly there developed signs of visceral carcinoma, of which the patient died. At no time, however, was there any sign of a recurrence in the breast or axillary area, proving, I think, that at the time I began the post-operative treatment the disease had already extended to other parts of the body. That is why I did not succeed in effecting a cure, although there was no recurrence in the area exposed to the ray.

As to the dosage given, we must be more accurate in the measurement of dosage. In speaking of dosage, we must be able to describe our technic, so that anybody can do the same thing. We have now sufficient means for accurately measuring the dosage so that we ought to be able to standardize our own technic. Perhaps it is not necessary to use these tests in every individual exposure, but we certainly should be able, by means of these tests, to standardize our tubes and technic so that when we expose for ten minutes under certain conditions we know just exactly what dose we are giving. We must keep in mind in this connection that the action of a tube is not always the same, even when the same technic is employed. With my forty-plate static machine, with the anode of the tube twelve inches from the patient, four milliamperes of current going through the tube, and a vacuum of six or seven Benoist, in two minutes will give me one-half a Kienboeck unit, the ray having passed through the leather filter. In deep-seated work I use four tubes, running each tube two minutes. These tubes run from the static machine, which is giving four milliamperes at the time, and will produce on the skin at that distance, with the filter, uniformly two Kienboeck units. Therefore, if I am giving five such doses, I am giving a full skin dose, which is ten units. If I want to give that much, I can do so, although I do not, as a rule. I can give it in any number of days, but when I have reached that unit I must be careful, and it is best to allow an interval of a week to pass before another dose is given. We must avoid burning the skin, and yet get all the penetration we can. The reason you get a skin effect and do not get penetration is because the tube runs down. When we start with a tube it is not as high after we get through with it. There is not the same vacuum and therefore we do not get the same quantity or quality of ray.

For measuring my dosage I use the Holzknecht modification of the Sabouraud method, which is supplied to the profession by M. Singer, of Wien, VIII Dansgasse, 2a.

DR. FEDOR HAENISCH, HAMBURG, GERMANY.

I may have misunderstood what was said about ante-operative treatment and, as that is dangerous ground, I want to be precise in my statements. I asked Dr. Johnston to tell me what dosage he gives in his ante-operative treatment. I will try the method but only under one condition, that the case is absolutely inoperable. I would never think of treating carcinoma in the chest with the Roentgen ray. I would decline to do so for several reasons.

Dr. Pfahler said that we get a lot of doubtful cases from the surgeons, but even that is rather dangerous, for the reason that if a woman finds out that there is no chance of getting rid of the node in the chest except by operation, she will jump at it and all our efforts to train them to have the breast removed thoroughly at the first sign of tumor will come to naught. We all know that not every case of carcinoma reacts properly under Roentgen treatment. Therefore, I believe that we are on dangerous ground when we postpone operation by giving ante-operative treatment in any case that is not absolutely inoperable. In these cases I will try the method and I shall endeavor to prevail on my colleagues to do likewise.

DR. GEORGE C. JOHNSTON (closing on his part).

I am familiar with Dr. Boggs' technic, having watched him work many times. The technic he uses in his ante-operative work is practically the same as he employs in post-operative work, and I think he is as negligent in the matter of dosage as I am. We neither of us employ as a routine measure any particular method of mensuration. We have at various times employed the Sabouraud and Noir pastilles, for the purpose of standardizing our particular forms of apparatus, to such an extent that we know very well what we are giving, but if we were to attempt to prescribe our doses for the use of any other roentgenologist on the same patient, we would have a sorry time doing it. The only way we could do it would be to remeasure our doses with the same instrument of precision, then give

it to the doctor, letting him take it home and standardize his machine accordingly. Then he must have from twelve to twenty-five seasoned tubes. I have twenty-five tubes, any one of which I can put on the machine, start it, leave it there, and at the end of a certain length of time the machine will stop itself. That is the method by which we work, and while it is crude, it is safe. Neither of us would use a tube or even keep a tube which will go down while it is on the machine. If it goes up, the automatic regulator will bring it down, but no regulator will bring it up. As long as we hear a little reaction going on in the tube, we know it is standing just where we placed it. After we have seen the apparatus working for a half an hour like it should, we do not worry. We buy our tubes low and then season them up. Many of the tubes are run for hours before they are ever used. Never think of using a tube until it will stand up and do the work.

Ante-operative treatment is only employed by Dr. Boggs and myself in those cases which are inoperable. What is an inoperable case? To the average man an operable case is any patient who can be placed on the table, operated on, and put back to bed alive. If the patient dies on the table, it is an inoperable case. The majority of our surgeons term as inoperable a case which they do not believe they can operate on and cure by means of a radical operation. We consider that as an at-present inoperable case, but one which we hope to transform into an operable case. While we have failed many times in this attempt, we can point with pride to some successes. We have had cases pronounced as distinctly inoperable by surgeons and transformed them into cases that the surgeons were glad to operate. Some of these patients are living three and four years after the operation, whereas the expectancy of life when first seen was not more than six months. Of course, they will die eventually from a mediastinal recurrence. I have never seen a case of carcinoma of the breast make a recovery after any procedure whatever when the patient had progressed to the stage of axillary and supraclavicular involvement. I have had a number of such cases shown

to me, but my standard of requirement for a case of carcinoma is high. The patient must have a carcinoma, the diagnosis to be supported by a competent patnologic examination; she must have been operated on for carcinoma, must have remained well for a period to exceed ten years, must die of some other disease and the post-mortem must reveal entire absence of any evidence of carcinoma elsewhere. That I consider to be a cure.

One of my very best friends, a surgeon, wrote a book on carcinoma of the breast and in it he reported a collection of cases in which a radical operation was performed, and he does a most beautiful radical operation. One of the cases mentioned in that book is a woman who remained cured ten years after the operation, and she was then under my care for a carcinoma of the lung, from which she died.

I saw a case of carcinoma, operated on twenty-one years before the patient was sent to me, and I found carcinoma in the supraclavicular glands and in the lung.

I read a paper on radiotherapy year after year. Even though it is not popular to read such papers, because we have to incur the ridicule and incredulity of the profession, there are men who have persistently produced results which can speak for themselves. The profession believes that radiotherapy is declining, whereas the contrary is the case. To us at the present time the securing of such results is an everyday occurrence, and we no longer think much of it. Nevertheless, we should call the attention of the profession to them, because it is certain that much good is being accomplished. I have given no credit to the work of anyone, but simply call attention to the fact that we are still getting good results.

There is a matter which we must consider always in speaking of malignancy. Microscopic and clinical malignancy are two separate things. The former gives no information as to the degree of malignancy, because it does not show the degree of susceptibility of the patient to the growth nor the degree of his resistance to the disease. It is my belief that when the supraclavicular and axillary glands are involved, the mediastinal glands are also involved. This is a question that has

been raised time and again, but I do not see why the infection should travel the longest way around. The path to the mediastinum is infinitely shorter than the path from the right breast to the left supraclavicular space. I have never seen a case of that kind where there was no evidence of mediastinal involvement.

We never delay by giving ante-operative treatment in an operable case. Such a case does not require ante-operative treatment.

We all make the mistake Dr. Pancoast spoke of, because we use protection on the tube. We use a protective with an aperture of four inches in diameter, and the Pfahler leather filter. I avoid the recurrences Dr. Pancoast mentioned by treating in a series of concentric circles from the center of the disease.

The surgeons of this country require education in one thing, and that is that a recurrence *in situ* of a malignant growth is a recurrence in the skin, and is due to the fault of not removing sufficient skin. It is absolutely necessary to remove every bit of skin which may be infected, and if the wound is too large for ordinary closure a skin graft should be used. Use the ray later, when the wound is closed by granulation. Remember, too, that the tension should not be too great and, if sufficient skin is removed to avoid a recurrence, tension is something to be reckoned with. Skin grafting would overcome this.

DR. RUDIS-JICINSKY (closing the discussion).

I am glad that Roentgen therapy has found some ardent workers in our midst and that we are beginning to understand what can be done with it.

With regard to the dosage, I have thrown out all the apparatus for measuring. I use my brain and my experience.

With regard to the treatment before and after operation, unfortunately I usually get these patients from the surgeon too late. He does not know what to do with them and then he sends them to the X-ray laboratory. You do not know the patient yourself. She remains with you for a week. You must

do something for her. Then you find out you do not need a surgeon and the glands are decreasing in size. The surgeon was not showing himself a friend of yours when he sent this patient. He was glad to get rid of her. We must study our cases individually and not only the tubes and apparatus. If we do that conscientiously we will get results which are better than they were years ago. Why? Because everyone of us has his own standard and knows what to do with his apparatus. With better apparatus our standards will improve.

DR. ALFRED L. GRAY, RICHMOND, VA.

Dr. Haenisch inquired what I mean by a post-operative series. My method is similar to that employed by Dr. Johnston. I can tell you what I do, but I cannot tell you how to do it. I have a number of seasoned tubes, whose capacity I have estimated from the standpoint of the coil I use. Using a tube with a penetration of about Walter 6, I find that by passing from one to one and a half milliamperes through that tube, which has an automatic regulator, my coil will produce a decided reaction on the unprotected skin at a distance of eight inches in thirty minutes. This is about one-half the time of any other apparatus working under the same conditions.

I had a rather painful experience when I learned that; I burned the face of a patient badly. From this fact, that these tubes working under these conditions, produce a reaction in thirty minutes by applying the law of inverse squares, I have made for this particular machine and particular apparatus a table by which I work.

In the post-operative breast cases my first series is usually given without a filter. I give thirteen treatments of five minutes' duration each, at a distance of twelve inches, on alternate days. That will usually produce a decided erythema. When I use a filter, I use a leather filter and give half as much again. With an aluminum filter I give doube as much, or more. I do not mean to advocate the administration of the primary maximum dose while the patient is still under ether and in the operating-room, but it is my hope that with these methods of

standardizing doses we may be able to cut down our maximum primary dose to five minutes with the apparatus in an adjoining room, so that the patient may easily be run in and treated.

DR. ALFRED L. GRAY, RICHMOND, VA.

In looking over my personal records, I have come to the conclusion that there is yet a great deal in the treatment of breast carcinoma that has not yet been brought out. The varying reports that Dr. Boggs has referred to, coming from different men, cannot but convince us that we are still deficient in our technic in the treatment of these cases. Dr. Boggs referred to the younger roentgenologists who are governed to some extent by the instructions given by the surgeons. If we are going to allow surgeons or anyone else to influence us in our methods of applying the ray, or in the frequency of its application, we should immediately give up our work. The surgeon should never be allowed to dictate to us any more than he would allow us to dictate to him.

I thought Dr. Boggs was not going to refer to the ante-operative treatment of carcinoma of the breast. I must confess that I was disappointed to hear him advocate such treatment. There is a time in the course of every carcinoma of the breast at which, so far as we now know, surgery is absolutely effective. We do not know when that time is at hand. Therefore, we may delay the operation until it is too late, and thereby render inoperable, a case which would probably have terminated favorably as the result of an immediate operation. For that reason I never give ante-operative treatment. No matter how small the nodule may be, I immediately refer the patient to a competent surgeon. When we take into consideration the fact that eighty per cent. of all tumors of the breast either are or will become malignant, the necessity for removing them is apparent. Therefore, I must differ from Dr. Boggs in his views concerning ante-operative treatment. I am firmly convinced, after an experience covering seven or eight years in the post-operative treatment of breast cancer, that every case should be submitted to post-operative treat-

ment at as early a time after the operation as possible. I have seen advocated, and theoretically I heartily approve, giving a maximum dose of the ray just before the closure of the skin wound. If we can have our machines so regulated as the Sabouraud method promises to enable us to do, we can give a little short of the maximum dose while the patient is still under the anesthetic. I am not so sure but what I shall advocate that procedure.

Dr. Boggs properly referred to the difficulty that is experienced in giving the proper amount of post-operative X-ray treatment. It is a very difficult thing to convince either the patient or the surgeon that after the wound is thoroughly healed and tenderness has subsided and flexibility returns to the scar, that in the course of a few months these patients should receive a second series of treatments, a third, and even a fourth. It is my advice to both patient and surgeon that at least three series of treatments should be given in the course of the first twelve months following the operation, and two in the second twelve months, persisting in this treatment though there is no evidence of recurrence. I attempt to follow out this method as nearly as possible.

In the inoperable cases, aside from the relief from pain, one of the greatest benefits of treatment by the Roentgen ray is the comfort to the patient's mind. I undertake to treat a patient sometimes with absolutely no hope of doing any permanent good whatever, because as long as she can feel that something is being done, it keeps her mind at ease, and she will continue to take interest in life for many days longer than she otherwise would. Of course I have a thorough understanding with the family of the sufferer, what my intentions are and what they should expect.

A NEW LOCALIZER.

The localizer devised by Dr. C. E. Coon, of Syracuse, N. Y., differs from the original Mackenzie-Davidson apparatus in the application of the thread and cross wire idea by means of simplified apparatus, which does away with tiresome adjustments and without sacrificing accuracy enables the operator to do everything, including placing of tube and patient, making exposures, developing plate and localizing, in a very few minutes. It is convenient for office use, requires only a small amount of storage room and is always ready for use.

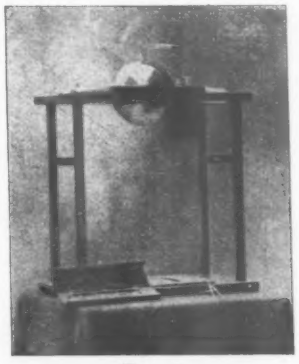


FIG. 1

Four uprights supporting longitudinal strips, top of these strips at a given distance from the base. The base carries a diaphragm cut out of heavy sheet brass, this is attached to base with hinges. The opening in diaphragm is fitted with crosswires and the intersection of these wires is located perpendicularly under the center of the area between the top strips, and the longitudinal wire parallel with the top pieces. Under the crosswire diaphragm the base is cut away and a piece of heavy ground glass is inserted flush with the surface. The top strips have cross markings in three places; the middle and at a given distance on either side for the purpose of centering the tube, to indicate the correct displacement in each direction and to support the wires which carry the threads.

The tube holder slides longitudinally along the upper surfaces of the top and fits to prevent lateral motion. On the under surface of side pieces and running transversely from center to center a V notch is cut. This holder will accommodate any of the commonly used tubes up to eight inches in

diameter. The anode end rests in a stationary notch in cross piece and the cathode end is received between two movable uprights provided with clamp; when closed these automatically lock the tube in center between top pieces. The focal point of anode is brought into line between the notches on under side of tubeholder and also on line of the top of the frame, the latter adjustment being made by raising or lowering the cathode end of the tube; when tube is locked in this position and holder placed on frame the focal point is at all times perpendicularly above the longitudinal cross-wire, and its distance from base is, of course, constant.

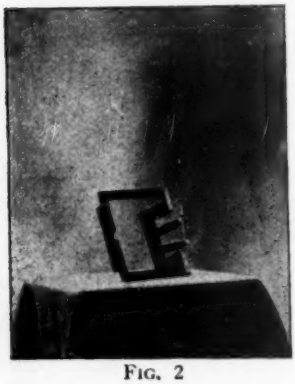


FIG. 2

Fig. 3 shows diaphragm raised for insertion of plate; it is not necessary to be exact in locating the plate; a notch in one side of the opening will indicate the position of the negative. The diaphragm is closed down on top of the plate, the cross-wires being moistened with tincture of iodine or other convenient marker, and the patient placed in proper position.

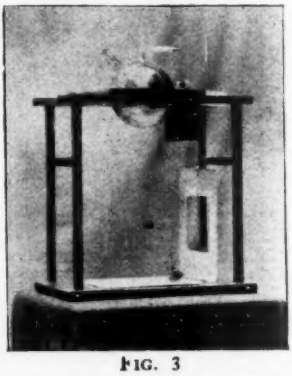


FIG. 3

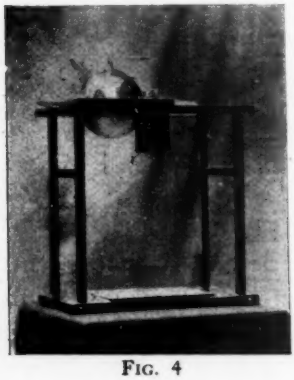


FIG. 4

Fig. 4. Position of tubeholder for one exposure. Notch on under side of holder placed over cross mark on top of frame.

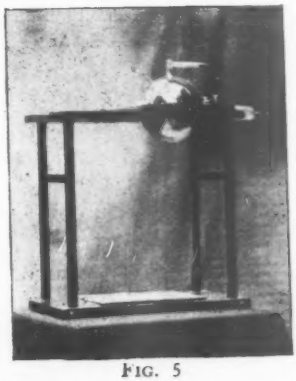


FIG. 5

Fig. 5. Position for second exposure. Notch on under surface of holder placed over cross mark opposite end of frame.

The negative shows outlines of diaphragm, the cross-wires and notch to indicate proper position in replacing plate. I have had little difficulty in getting two satisfactory exposures on one plate; some of the more difficult locations have been:—hypodermic needle in buttocks; fragment of steel in eye; fragment of steel in sheath of sciatic nerve in middle of thigh; bullet in front of lumbar vertebrae; concretions in vermiform appendix, etc.

Fig. 6. Looking at the top of the frame, shows cross-marks described earlier, and extending between the outer marks a wire with notch in center to carry threads attached to mouse weights; these wires being held in place and prevented from getting off-center by being bent at right angles at each end and fitted into socket on top pieces.

FIG. 6

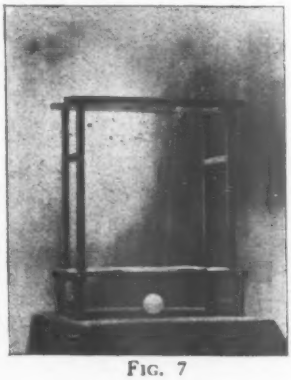


FIG. 7

Fig. 7. Arranged for transillumination, threads and mouse-weights in position, and ready to make the three necessary measurements.

When not in use, the legs for elevating the base to allow placing of electric lamp underneath, are folded along side of base.

EDITORIAL.

It was the universal verdict of those who attended the Detroit meeting that it was a great success. This is due to the fact that all the members who attended entered into the spirit of the occasion, and contributed to make the meeting an harmonious affair. The originality of the papers read and the thoughtful discussions contributed very much to the quality of the meeting.

The outlook for the Richmond meeting is very bright. The executive committee has about decided to hold a four day meeting in place of a three day meeting, inasmuch as it is thought that the programme will take that amount of time, and that this plan will give a better arrangement for discussions and afford opportunities for the men to get together and have the private discussions which make up such an important feature of the annual meetings. Our members do not need any assurance that the famous Southern hospitality will be extended to them and will provide generously for their entertainment during the coming meeting. Further announcement with regards to this meeting will appear in the next number of the Quarterly.

In a conversation which the writer had with the Medical director of a large Eastern Insurance company, he was told that the Medical Director had recently refused two of our well known members in their applications for insurance. His reason for so doing was that the occupation of Roentgenologist is classed as an extra hazardous occupation, and on that account, he did not consider that the average X-ray worker was a good risk. Upon further questioning, he admitted if the Roentgenologists could prove that their work was being so safe guarded that the dangers, which have been exploited so much in the public press, were a thing of the past, that these rejections would be done away with. Such comment by one who regards our work from purely a business standpoint, certainly should give us food for mature reflection. If we are to be classed in our occupation as running equal hazards with automobile testers and brakemen, it would seem as

though we should demand from the public who seek our services an adequate compensation for the danger which we incur.

The delay in the issue of the December number was a subject of great regret to those who had the task of bringing out the last number of the Quarterly. However, it will be the desire to avoid such delays in the future, and if arrangement could be made so that at the annual meeting those who have the tasks of tabulating manuscripts and arranging for illustrations could make verbal arrangements instead of having to spend so much time in long winded correspondence, much delay would be avoided.

The Eastern members who were fortunate enough to attend the Section meeting in New York, report that the day was spent very profitably. These Section meetings will undoubtedly be one of the features of our society, and will tend to keep up the interest in the membership. It is announced that the Section for the Western members will be held in Chicago, April 8th, 1911. The local arrangements are in the hands of Dr. Hollis Potter.

Richmond, the capital of the Mother of States, the capital of the Confederacy, historic, cultured, the modern, up-to-date city,—hospitable Richmond extends to the American Roentgen Ray Society a most cordial welcome.

The seasons at which Richmond is at her best are the late spring and early autumn months. Being midway between the North and the South, these are the seasons that bring her the most visitors.

The city is becoming noted as a meeting place for conventions. The magnificent hotel accommodations and excellent convention halls offer inducements that few cities of its size can present.

The facilities offered by the dozen steam and electric railways and the steamship lines render Richmond accessible from all points of the compass. The suburban electric lines, which are numerous, offer those especially interested in the

historic, abundant facilities for viewing the battle grounds, monuments, and cemeteries that mark the struggles of war.

The vicinity of Richmond is well supplied with good driveways, and during the visit of the Society opportunity will be given for automobile rides over the oiled roads.

Among the objects of greatest interest from a historical point of view may be mentioned: Powhatan, the place of rescue of Captain John Smith by Pocahontas; Washington's Headquarters; St. John's Church where Patrick Henry made his famous speech; St. Paul's Church containing the pews of Jefferson Davis and General Lee; Monumental Church built on the site of the old theater, which was burned and in which Governor Smith and many others lost their lives; The Capitol Square, in which are situated the Washington Monument, Stonewall Jackson Monument, Henry Clay Monument, Governor Smith Monument, the Hunter McGuire Monument, and in the State Capitol the original Houdon Statue of Washington.

From a medical standpoint, Richmond offers two Medical Colleges, both of which are ranked in the highest class, many excellent general hospitals and private surgical and special hospitals second to none in equipment and efficiency.

Beautiful Hollywood Cemetery contains the graves of Presidents Monroe and Tyler, Commodore Maury, John Randolph of Roanoke, Jefferson Davis, and many of the Confederate generals.

Other points of especial interest in and around the city are: Libby Prison site, Residence of General R. E. Lee, Lee Monument, Jefferson Davis Monument, J. E. B. Stuart Monument, A. P. Hill Monument, Jefferson Davis Mansion, now the Confederate Museum, Residence of Chief Justice Marshall, the Valentine Museum of Sculpture, and the Confederate Soldiers' Home. To those who have the opportunity, a trip down the historic James River, through Dutch Gap and by Jamestown Island will be found delightful, interesting and instructive.

These, however, are not the real reasons why the Society is going to have the most successful meeting of its history

in Richmond in September. Under the leadership of such eminent, energetic and influential men as those who grace the executive offices, a most interesting and instructive pro gram is assured, and, too, the three local members are interesting their friends of the Medical Profession and the public in the coming meeting, and with the co-operation of the Management of the Jefferson Hotel, where the Society will meet, will leave no stone unturned to make the meeting of 1911 long to be remembered as one of the brightest pages in the record of the A. R. R. S.

H. K. PANCOAST,
Chairman Executive Committee.
A. L. GRAY,
Chairman Local Committee of Arrangements.

ABSTRACTS FROM ENGLISH LITERATURE

ROENTGENOGRAPHIC EXAMINATION OF THE BLADDER.

Dr. John M. Garratt, Jour. A. M. A., Jan. 28, '11, p. 264, proposes to outline the size, position and conformation of the bladder by filling with bismuth (50), kaolin (250), water (1,000.) States that the mixture is well borne, being, in one case, the only injection the patient retained with comfort.

D. R. B.

POST-OPERATIVE ROENTGENIZATION OF CANCER.

In the "Therapeutics" section, Jour. A. M. A., Jan. 21, '11, p. 195, this subject is so ably summarized that we regret the omission of the writer's name.

The attitude of the roentgenologist, of the average surgeon, and the consideration of the patient are presented fully and consistently. "The dictum taught and written has been 'use the X-ray in inoperable cases and * * * the X-ray did not derive much credit from its use in these cases. It is indeed a

tremendous tribute to its actual power that it derived any credit at all.' By first extirpating as extensively as possible in such cases, however, the amount of work to be demanded of the X-ray and the amount of contingent toxemia are tremendously lessened, and both measures are given opportunity to do their utmost under most favorable circumstances."

The subject of pre-operative Roentgenization is reviewed from an antagonistic standpoint, concluding: "If the effective pre-operative radiation were devoid of danger, the delay of operation involved would not be objectionable, but we have seen that this is not the case. (This dictum is sure to be rendered obsolete by improved technic in the measurement of dosage.—Ed.) Just so long as the ablative procedure is delayed, by just so long is the period during which sound tissues are threatened increased.

"A final word may properly be said regarding the operator. * * * As a matter of fact it may be interesting to know that those competent to judge estimate the number of competent radiotherapists in the United States at less than forty.

"Great pains should be taken, then, to send patients to some one who is profoundly versed in the technic, and thoroughly experienced in the practice of Roentgen-therapy.

"If any other has been intrusted with the application in any given case and good results have not followed, the method should not be blamed, but the responsibility placed where it belongs and a competent operator selected next time."

D. R. B.

PRESENT POSITION OF THE X-RAY IN THE TREATMENT OF RING-WORM.

S. Ernest Dore, M. D., London. Lancet, Feb. 18, '11, p. 432. History, advantages, and dangers considered at length, concluding:

"The method which I have found superior to all others, both in efficiency and in saving of time, is that first suggested by Kienbock and subsequently elaborated by Adamson.

"The tube is placed in a box having an aperature of at least three inches for the passage of rays. Three wooden pegs project from the margin of this opening, so that the tube is at the correct distance from the skin when they rest on the scalp.

"The child's hair having been clipped short, the scalp is marked out, five equidistant points being taken as a centre for each exposure. Allowing fifteen minutes as an average exposure, the whole scalp can be treated in one and a half hours.

"Hair begins to fall, usually, on fourteenth or fifteenth day. In three weeks the child is quite bald and free from infection. New hair appears in about six weeks, and in three months the scalp is well covered.

"When fully grown the new hair is often thicker in texture and slightly darker in color and, occasionally, curly instead of straight. In private practice, since I adopted this method one year ago, and at the Evelin Hospital (where more than one hundred cases have been treated) the results have not only been more satisfactory than before, but the saving of time has enabled a larger number of hospital cases to be dealt with without any increase of risk to the children." D. R. B.

SOME INVESTIGATIONS CONCERNING THE RELATION BETWEEN CARPAL OSSIFICATION AND PHYSICAL AND MENTAL DEVELOPMENT.

Dr. Eli Long and Dr. E. W. Caldwell, New York. Am. Jour. Diseases of Children, Feb., 1911, p. 113.

A long paper illustrated by many plates and charts, concluding:

"From this limited investigation we are led to believe that the ossification of one wrist of an individual is not an exact index of the ossification in the other wrist, and, therefore, it seems probable that the same inexact relation exists between the wrist and the remainder of the skeleton.

"Age, height, and weight, increase in general with the advance in carpal ossification, but with many exceptions in

both sexes. It would be impractical at least, to regulate the mode of life of these children according to this classification alone.

"We find no relation between the degree of carpal development and quality of mind. The relationship between the stages of puberty and those of carpal ossification is too indefinite to warrant the latter's use as an index of physiological development. And, finally, though carpal development alone is not an exact index still, when observed at intervals and considered with other factors, it may become an aid in estimating the rapidity of growth of the skeleton in children."

D. R. B.